***Supplementary Material***

***Error rates analysis***

The ANOVA on error rates showed significant main effects of Age *F*(2, 91) = 22.867; *p* < 0.001, *ƞ2p* = 0.334, Condition *F*(2, 90) = 51.112; *p* < 0.001, *ƞ2p* = 0.360 and Trial type *F*(1, 91) = 101.536; *p* < 0.001, *ƞ2p* = 0.527. Two-way interactions of Condition X Age *F*(4, 182) = 12.639; *p* < 0.001, *ƞ2p* = 0.217, Trial type X Age *F*(2, 91) = 14.679; *p* < 0.001, *ƞ2p* = 0.244, and Condition X Trial type *F*(2, 90) = 15.933; *p* < 0.001, *ƞ2p* = 0.149, were also significant. Three-way interaction between Condition, Trial type, and Age *F*(4, 182) = 5.793; *p* < 0.001, *ƞ2p* = 0.113 was also significantly affecting error rates.

Error rates of the “Proactive Impossible” (4.77%) and “Proactive Possible” (4.38%) condition did not differ significantly, however, the highest error rates were found in the “Proactive Encouraged” condition (10.83%) compared to the other two conditions, *p* < 0.001. Children showed higher error rates in switch trials (9.59%) than in repeat trials (3.73%), p < 0.001. Five-year-olds (11.45%) made the highest errors compared to older age groups, whereas there was no significant difference between 6-8- (5.32%) and 9-11-year-olds (3.22%) (Figure 2B). *(Refer to Appendix A-Table 1 for descriptive statistics for mean and standard deviation of each condition by trial type and age for error rate analysis).*

There was no significant difference in error rates across age groups in the “Proactive Impossible” and “Proactive Possible” conditions, however in the “Proactive Encouraged” condition, we found that 5-year-olds made significantly higher errors (19.45%) than older age groups (8.85% and 4.2% in 6-8- and 9-11-year-olds respectively).

In both 5 and 6-8-year-olds, switch trials (16.57% and 7.57%, respectively) had significantly higher error rates compared to repeat trials (6.33% and 3.07%, respectively), *p* < 0.001, however, there was no significant difference between switch and repeat trials in 9-11-year-olds. 6-8- and 9-11-year-olds did not differ significantly in both switch and repeat trials. However, in both trial types 5-year-olds made the highest errors (Figure 2B). In switch trials, there was no significant difference found in “Proactive Impossible” and “Proactive Possible” conditions across age groups, however in the “Proactive Encouraged” condition, there was a significant difference across age groups, showing the highest error rates in 5-year-olds compared to older age groups. In switch trials, there was no significant difference between “Proactive Impossible” and “Proactive Possible” conditions in five- and 6-8-year-olds, however, in 9-11-year-olds there was no significant difference across all conditions. In switch trials, both five- (2.87%) and 6-8-year-olds (1.27%) had significantly higher error rates in the “Proactive Encouraged” condition.

In terms of accuracy switch costs, as expected, all age groups had higher switch costs in the “Proactive Encouraged” condition compared to the other two conditions, and five-year-olds had higher switch costs compared to older age groups. In both 6-8- and 9-11-year-olds, switch costs did not differ significantly across conditions, however, five-year-olds had higher switch costs in the “Proactive Encouraged” condition. On the other hand, only in “Proactive Encouraged” condition five-year-olds were found to have higher switch costs than older age groups.

**Table S1**

*Three-way ANOVA for Error Rate analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 0.682 | 2 | 0.341 | 22.867 | <0.001 | 0.334 |
| Residuals | 1.356 | 91 | 0.015 |  |  |  |
| Condition | 0.492 | 2 | 0.246 | 51.112 | < .001 | 0.360 |
| Condition \* Age Group | 0.243 | 4 | 0.061 | 12.639 | < .001 | 0.217 |
| Residuals | 0.877 | 182 | 0.005 |  |  |  |
| Trial Type | 0.483 | 1 | 0.483 | 101.536 | < .001 | 0.527 |
| Trial Type \* Age Group | 0.140 | 2 | 0.070 | 14.679 | < .001 | 0.244 |
| Residuals | 0.432 | 91 | 0.005 |  |  |  |
| Condition \* Trial Type | 0.110 | 2 | 0.055 | 15.933 | < .001 | 0.149 |
| Condition \* Trial Type \* Age Group | 0.080 | 4 | 0.020 | 5.793 | < .001 | 0.113 |
| Residuals | 0.628 | 182 | 0.003 |  |  |  |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC).

Trial type: Switch and Repeat trials

**Table S2**

*Post-hoc comparison for the interaction between Age Group and Condition in the Error Rate analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Mean Difference** | **SE** | **t** | **Cohen’s d** | ***pbonf*** |
| 5 years | 6-8 years | 0.061 | 0.013 | 4.800 | 0.789 | <0.001\*\*\* |
|  | 9-11 years | 0.082 | 0.013 | 6.558 | 1.061 | <0.001\*\*\* |
| 6-8 years | 9-11 years | 0.021 | 0.012 | 1.699 | 0.273 | 0.278 |
| Switch | Repeat | 0.059 | 0.006 | 10.076 | 0.754 | <0.001\*\*\* |
| PIC | PPC | 0.004 | 0.007 | 0.538 | 0.050 | 1.000 |
|  | PEC | -0.061 | 0.007 | -8.474 | -0.782 | <0.001\*\*\* |
| PPC | PEC | -0.065 | 0.007 | -9.013 | -0.831 | <0.001\*\*\* |
| 5 years, PIC | 6-8 years, PIC | 0.045 | 0.016 | 2.752 | 0.580 | 0.232 |
|  | 9-11 years, PIC | 0.056 | 0.016 | 3.467 | 0.720 | 0.023\* |
| 6-8-years, PIC | 9-11 years, PIC | 0.011 | 0.016 | 0.678 | 0.140 | 1.000 |
| 5 years, PPC | 6-8 years, PPC | 0.033 | 0.016 | 2.004 | 0.423 | 1.000 |
|  | 9-11 years, PPC | 0.038 | 0.016 | 2.379 | 0.494 | 0.658 |
| 6-8-years, PPC | 9-11 years, PPC | 0.006 | 0.016 | 0.347 | 0.072 | 1.000 |
| 5 years, PEC | 6-8 years, PEC | 0.106 | 0.016 | 6.465 | 1.363 | <0.001\*\*\* |
|  | 9-11 years, PEC | 0.153 | 0.016 | 9.486 | 1.970 | <0.001\*\*\* |
| 6-8-years, PEC | 9-11 years, PEC | 0.047 | 0.016 | 2.947 | 0.607 | 0.129 |
| 5 years, PIC | 5 years, PPC | 0.014 | 0.013 | 1.088 | 0.178 | 1.000 |
|  | 5 years, PEC | -0.113 | 0.013 | -8.945 | -1.459 | <0.001\*\*\* |
| 5 years, PPC | 5 years, PEC | -0.127 | 0.013 | -10.033 | -1.637 | <0.001\*\*\* |
| 6-8 years, PIC | 6-8 years, PPC | 0.002 | 0.012 | 0.123 | 0.020 | 1.000 |
|  | 6-8 years, PEC | -0.053 | 0.012 | -4.215 | -0.676 | 0.001\*\* |
| 6-8 years, PPC | 6-8 years, PEC | -0.054 | 0.012 | -4.338 | -0.696 | <0.001\*\*\* |
| 9-11 years, PIC | 9-11 years, PPC | -0.004 | 0.012 | -0.311 | -0.048 | 1.000 |
|  | 9-11 years, PEC | -0.016 | 0.012 | -1.345 | -0.209 | 1.000 |
| 9-11 years, PPC | 9-11 years, PEC | -0.012 | 0.012 | -1.034 | -0.161 | 1.000 |
| 5 years, Switch | 6-8 years, Switch | 0.090 | 0.015 | 6.134 | 1.158 | <0.001\*\*\* |
|  | 9-11 years, Switch | 0.119 | 0.014 | 8.269 | 1.537 | <0.001\*\*\* |
| 6-8-years, Switch | 9-11 years, Switch | 0.029 | 0.014 | 2.059 | 0.379 | 0.620 |
| 5 years, Repeat | 6-8 years, Repeat | 0.033 | 0.015 | 2.224 | 0.420 | 0.416 |
|  | 9-11 years, Repeat | 0.045 | 0.014 | 3.151 | 0.586 | 0.030\* |
| 6-8-years, Repeat | 9-11 years, Repeat | 0.013 | 0.014 | 0.900 | 0.166 | 1.000 |
| 5 years, Switch | 5 years, Repeat | 0.102 | 0.010 | 9.953 | 1.317 | <0.001\*\*\* |
| 6-8 years, Switch | 6-8 years, Repeat | 0.045 | 0.014 | 4.448 | 0.579 | <0.001\*\*\* |
| 9-11 years, Switch | 9-11 years, Repeat | 0.028 | 0.010 | 2.897 | 0.366 | 0.071 |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

*\*p* < 0.05; *\*\*p* < 0.01; *\*\*\*p* < 0.001

**ANOVA and post-hoc tables**

**Table S3**

*Three-way ANOVA for Reaction Time (RT) (log values)*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 19.645 | 2 | 9.823 | 53.934 | < .001 | 0.542 |
| Residuals | 16.573 | 91 | 0.182 |  |  |  |
| Condition | 3.848 | 2 | 1.924 | 58.970 | < .001 | 0.393 |
| Condition \* Age Group | 0.561 | 4 | 0.140 | 4.303 | 0.002 | 0.086 |
| Residuals | 5.937 | 182 | 0.033 |  |  |  |
| Trial Type | 0.020 | 1 | 0.020 | 2.821 | 0.096 | 0.030 |
| Trial Type \* Age Group | 0.045 | 2 | 0.022 | 3.160 | 0.047 | 0.065 |
| Residuals | 0.645 | 91 | 0.007 |  |  |  |
| Condition \* Trial Type | 0.011 | 2 | 0.005 | 1.533 | 0.219 | 0.017 |
| Condition \* Trial Type \* Age Group | 0.010 | 4 | 0.002 | 0.702 | 0.591 | 0.015 |
| Residuals | 0.641 | 182 | 0.004 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial Type: Switch and Repeat trials

**Table S4**

*Post-hoc comparisons for the interaction between Age Group and Condition in the Reaction Time (RT) analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Mean Difference** | **SE** | **t** | **Cohen’s d** | ***pbonf*** |
| 5 years | 6-8 years | 0.300 | 0.045 | 6.722 | 1.437 | <0.001\*\*\* |
|  | 9-11 years | 0.450 | 0.044 | 10.250 | 2.158 | <0.001\*\*\* |
| 6-8 years | 9-11 years | 0.151 | 0.044 | 3.455 | 0.721 | 0.003\*\* |
| Switch | Repeat | 0.012 | 0.007 | 1.680 | 0.057 | 0.096 |
| PIC | PPC | 0.077 | 0.019 | 4.148 | 0.370 | <0.001\*\*\* |
|  | PEC | 0.201 | 0.019 | 10.766 | 0.961 | <0.001\*\*\* |
| PPC | PEC | 0.123 | 0.019 | 6.618 | 0.591 | <0.001\*\*\* |
| 5 years, PIC | 6-8 years, PIC | 0.263 | 0.052 | 5.050 | 1.258 | <0.001\*\*\* |
|  | 9-11 years, PIC | 0.390 | 0.051 | 7.622 | 1.870 | <0.001\*\*\* |
| 6-8-years, PIC | 9-11 years, PIC | 0.128 | 0.051 | 2.516 | 0.612 | 0.463 |
| 5 years, PPC | 6-8 years, PPC | 0.379 | 0.052 | 7.286 | 1.815 | <0.001\*\*\* |
|  | 9-11 years, PPC | 0.555 | 0.051 | 10.843 | 2.660 | <0.001\*\*\* |
| 6-8-years, PPC | 9-11 years, PPC | 0.177 | 0.051 | 3.475 | 0.845 | 0.024\* |
| 5 years, PEC | 6-8 years, PEC | 0.258 | 0.052 | 4.968 | 1.237 | <0.001\*\*\* |
|  | 9-11 years, PEC | 0.406 | 0.051 | 7.920 | 1.943 | <0.001\*\*\* |
| 6-8-years, PEC | 9-11 years, PEC | 0.147 | 0.051 | 2.901 | 0.706 | 0.153 |
| 5 years, PIC | 5 years, PPC | -0.016 | 0.033 | -0.498 | -0.079 | 1.000 |
|  | 5 years, PEC | 0.197 | 0.033 | 5.976 | 0.944 | <0.001\*\*\* |
| 5 years, PPC | 5 years, PEC | 0.213 | 0.033 | 6.474 | 1.023 | <0.001\*\*\* |
| 6-8 years, PIC | 6-8 years, PPC | 0.100 | 0.032 | 3.078 | 0.478 | 0.087 |
|  | 6-8 years, PEC | 0.193 | 0.032 | 5.942 | 0.923 | <0.001\*\*\* |
| 6-8 years, PPC | 6-8 years, PEC | 0.093 | 0.032 | 2.864 | 0.445 | 0.168 |
| 9-11 years, PIC | 9-11 years, PPC | 0.149 | 0.031 | 4.725 | 0.712 | <0.001\*\*\* |
|  | 9-11 years, PEC | 0.212 | 0.031 | 6.753 | 1.017 | <0.001\*\*\* |
| 9-11 years, PPC | 9-11 years, PEC | 0.064 | 0.031 | 2.028 | 0.305 | 1.000 |
| 5 years, Switch | 6-8 years, Switch | 0.310 | 0.045 | 6.819 | 1.486 | <0.001\*\*\* |
|  | 9-11 years, Switch | 0.472 | 0.045 | 10.542 | 2.262 | <0.001\*\*\* |
| 6-8-years, Switch | 9-11 years, Switch | 0.162 | 0.044 | 3.650 | 0.777 | 0.006\*\* |
| 5 years, Repeat | 6-8 years, Repeat | 0.290 | 0.045 | 6.371 | 1.388 | <0.001\*\*\* |
|  | 9-11 years, Repeat | 0.429 | 0.045 | 9.571 | 2.054 | <0.001\*\*\* |
| 6-8-years, Repeat | 9-11 years, Repeat | 0.139 | 0.044 | 3.129 | 0.666 | 0.035\* |
| 5 years, Switch | 5 years, Repeat | 0.033 | 0.013 | 2.646 | 0.159 | 0.144 |
| 6-8 years, Switch | 6-8 years, Repeat | 0.013 | 0.012 | 1.040 | 0.061 | 1.000 |
| 9-11 years, Switch | 9-11 years, Repeat | -0.010 | 0.012 | -0.860 | -0.049 | 1.000 |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

*\*p* < 0.05; *\*\*p* < 0.01; *\*\*\*p* < 0.001

**Table S5**

*Three-way ANOVA for IES analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 12.425 | 2 | 6.213 | 6.955 | 0.002 | 0.150 |
| Residuals | 70.570 | 79 | 0.893 |  |  |  |
| Condition | 19.038 | 2 | 9.519 | 14.214 | < .001 | 0.152 |
| Condition \* Age Group | 8.695 | 4 | 2.174 | 3.246 | 0.014 | 0.076 |
| Residuals | 105.81 | 158 | 0.67 |  |  |  |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

**Table S6**

*Post-hoc comparisons for the interactions between Age Group and Condition in the IES analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Mean Difference** | **SE** | **t** | **Cohen’s d** | **pbonf** |
| 5 years | 6-8 years | 0.386 | 0.159 | 2.434 | 0.447 | 0.052 |
|  | 9-11 years | 0.576 | 0.155 | 3.723 | 0.667 | 0.001\*\* |
| 6-8 years | 9-11 years | 0.19 | 0.139 | 1.366 | 0.22 | 0.527 |
| PIC | PPC | -0.037 | 0.131 | -0.287 | -0.043 | 1.000 |
|  | PEC | -0.621 | 0.131 | -4.754 | -0.72 | < .001\*\*\* |
| PPC | PEC | -0.584 | 0.131 | -4.467 | -0.677 | < .001\*\*\* |
| 5 years, PIC | 6-8 years, PIC | 0.196 | 0.251 | 0.783 | 0.227 | 1.000 |
|  | 9-11 years, PIC | 0.26 | 0.244 | 1.064 | 0.301 | 1.000 |
| 6-8-years, PIC | 9-11 years, PIC | 0.064 | 0.22 | 0.291 | 0.074 | 1.000 |
| 5 years, PPC | 6-8 years, PPC | 0.387 | 0.251 | 1.543 | 0.448 | 1.000 |
|  | 9-11 years, PPC | 0.268 | 0.244 | 1.097 | 0.311 | 1.000 |
| 6-8-years, PPC | 9-11 years, PPC | -0.119 | 0.22 | -0.541 | -0.138 | 1.000 |
| 5 years, PEC | 6-8 years, PEC | 0.575 | 0.251 | 2.292 | 0.666 | 0.82 |
|  | 9-11 years, PEC | 1.199 | 0.244 | 4.904 | 1.39 | < .001\*\*\* |
| 6-8-years, PEC | 9-11 years, PEC | 0.624 | 0.22 | 2.842 | 0.723 | 0.176 |
| 5 years, PIC | 5 years, PPC | -0.104 | 0.259 | -0.401 | -0.12 | 1.000 |
|  | 5 years, PEC | -1.061 | 0.259 | -4.098 | -1.229 | 0.002\*\* |
| 5 years, PPC | 5 years, PEC | -0.957 | 0.259 | -3.697 | -1.109 | 0.011\* |
| 6-8 years, PIC | 6-8 years, PPC | 0.087 | 0.215 | 0.405 | 0.101 | 1.000 |
|  | 6-8 years, PEC | -0.682 | 0.215 | -3.173 | -0.79 | 0.065 |
| 6-8 years, PPC | 6-8 years, PEC | -0.769 | 0.215 | -3.578 | -0.891 | 0.017\* |
| 9-11 years, PIC | 9-11 years, PPC | -0.096 | 0.201 | -0.475 | -0.111 | 1.000 |
|  | 9-11 years, PEC | -0.122 | 0.201 | -0.604 | -0.141 | 1.000 |
| 9-11 years, PPC | 9-11 years, PEC | -0.026 | 0.201 | -0.129 | -0.03 | 1.000 |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

*\*p* < 0.05; *\*\*p* < 0.01; *\*\*\*p* < 0.001

**Table S7**

*Three-way ANOVA for LISAS analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 24.854 | 2 | 12.427 | 62.899 | <0.001 | 0.580 |
| Residuals | 17.979 | 91 | 0.198 |  |  |  |
| Condition | 2.378 | 2 | 1.189 | 34.804 | < .001 | 0.277 |
| Condition \* Age Group | 0.372 | 4 | 0.093 | 2.720 | 0.031 | 0.056 |
| Residuals | 6.218 | 182 | 0.034 |  |   |  |
| Trial Type | 0.239 | 1 | 0.239 | 23.309 | < .001 | 0.204 |
| Trial Type \* Age Group | 0.137 | 2 | 0.069 | 6.692 | 0.002 | 0.128 |
| Residuals | 0.935 | 91 | 0.010 |  |   |  |
| Condition \* Trial Type | 0.026 | 2 | 0.013 | 2.228 | 0.111 | 0.024 |
| Condition \* Trial Type \* Age Group | 0.022 | 4 | 0.005 | 0.940 | 0.442 | 0.020 |
| Residuals | 1.046 | 182 | 0.006 |  |  |  |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

**Table S8**

*Post-hoc comparisons for the interaction between Age Group and Condition in the LISAS analysis*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Mean Difference** | **SE** | **t** | **Cohen’s d** | ***pbonf*** |
| 5 years | 6-8 years | 0.341 | 0.046 | 7.330 | 1.556 | <0.001\*\*\* |
|  | 9-11 years | 0.506 | 0.046 | 11.054 | 2.311 | <0.001\*\*\* |
| 6-8 years | 9-11 years | 0.165 | 0.045 | 3.644 | 0.755 | 0.001\*\* |
| Switch | Repeat | 0.041 | 0.009 | 4.828 | 0.188 | <0.001\*\*\* |
| PIC | PPC | 0.073 | 0.019 | 3.826 | 0.333 | <0.001\*\*\* |
|  | PEC | 0.159 | 0.019 | 8.334 | 0.736 | <0.001\*\*\* |
| PPC | PEC | 0.086 | 0.019 | 4.508 | 0.393 | <0.001\*\*\* |
| 5 years, PIC | 6-8 years, PIC | 0.298 | 0.054 | 5.521 | 1.359 | <0.001\*\*\* |
|  | 9-11 years, PIC | 0.434 | 0.053 | 8.175 | 1.983 | <0.001\*\*\* |
| 6-8-years, PIC | 9-11 years, PIC | 0.136 | 0.053 | 2.592 | 0.623 | 0.376 |
| 5 years, PPC | 6-8 years, PPC | 0.401 | 0.054 | 7.429 | 1.829 | <0.001\*\*\* |
|  | 9-11 years, PPC | 0.582 | 0.053 | 10.962 | 2.659 | <0.001\*\*\* |
| 6-8-years, PPC | 9-11 years, PPC | 0.182 | 0.053 | 3.449 | 0.829 | 0.026\* |
| 5 years, PEC | 6-8 years, PEC | 0.324 | 0.054 | 6.004 | 1.478 | <0.001\*\*\* |
|  | 9-11 years, PEC | 0.502 | 0.053 | 9.449 | 2.292 | <0.001\*\*\* |
| 6-8-years, PEC | 9-11 years, PEC | 0.178 | 0.053 | 3.382 | 0.813 | 0.033\* |
| 5 years, PIC | 5 years, PPC | -0.011 | 0.034 | -0.314 | -0.048 | 1.000 |
|  | 5 years, PEC | 0.128 | 0.034 | 3.787 | 0.584 | 0.007\*\* |
| 5 years, PPC | 5 years, PEC | 0.138 | 0.034 | 4.101 | 0.632 | 0.002\*\* |
| 6-8 years, PIC | 6-8 years, PPC | 0.092 | 0.033 | 2.779 | 0.421 | 0.217 |
|  | 6-8 years, PEC | 0.154 | 0.033 | 4.633 | 0.702 | <0.001\*\*\* |
| 6-8 years, PPC | 6-8 years, PEC | 0.062 | 0.033 | 1.854 | 0.281 | 1.000 |
| 9-11 years, PIC | 9-11 years, PPC | 0.137 | 0.032 | 4.269 | 0.627 | 0.001\*\* |
|  | 9-11 years, PEC | 0.195 | 0.032 | 6.073 | 0.892 | <0.001\*\*\* |
| 9-11 years, PPC | 9-11 years, PEC | 0.058 | 0.032 | 1.804 | 0.265 | 1.000 |
| 5 years, Switch | 6-8 years, Switch | 0.365 | 0.048 | 7.655 | 1.666 | < .001\*\*\* |
|  | 9-11 years, Switch | 0.544 | 0.047 | 11.584 | 2.484 | < .001\*\*\* |
| 6-8-years, Switch | 9-11 years, Switch | 0.179 | 0.047 | 3.845 | 0.817 | 0.003\*\* |
| 5 years, Repeat | 6-8 years, Repeat | 0.316 | 0.048 | 6.638 | 1.445 | < .001\*\*\* |
|  | 9-11 years, Repeat | 0.468 | 0.047 | 9.972 | 2.138 | < .001\*\*\* |
| 6-8-years, Repeat | 9-11 years, Repeat | 0.152 | 0.047 | 3.26 | 0.693 | 0.023\* |
| 5 years, Switch | 5 years, Repeat | 0.083 | 0.015 | 5.47 | 0.377 | < .001\*\*\* |
| 6-8 years, Switch | 6-8 years, Repeat | 0.034 | 0.015 | 2.297 | 0.156 | 0.359 |
| 9-11 years, Switch | 9-11 years, Repeat | 0.007 | 0.014 | 0.482 | 0.032 | 1.000 |

*Note:*

Age group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

*\*p* < 0.05; *\*\*p* < 0.01; *\*\*\*p* < 0.001

***Results based on covariate analysis with background variables***

Test of fluid intelligence (Colored Progressive Matrices, CPM) and socio-economic status (SES) were taken as covariates with each of the dependent measures (RT, error rates, LISAS and IES).

*Fluid intelligence as covariate*

A three-way ANOVA with age (5, 6-8 and 9-11 years), condition (Proactive Impossible Condition, Proactive Possible Condition and Proactive Encouraged Condition), and trial type (Switch and Repeat) was performed with log-transformed RTs as the dependent measure and CPM score as covariate. The main effect of CPM was not found to be significant *F*(1, 90) = 0.267; *p* = 0.607 , *ƞ2p* = 0.003, whereas the main effect of Age Group was significant *F*(2, 90) = 46.609; *p* < 0.001, *ƞ2p* = 0.509. The interaction between CPM and other independent variables were not significant in RT analysis. Interaction between Age Group and Condition was significant *F*(4, 180) = 3.744; *p* = 0.006, *ƞ2p* = 0.077.

**Table S9**

*Three-way ANOVA with Reaction Time (RT) as dependent variable and fluid intelligence (CPM) as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 17.303 | 2 | 8.651 | 46.609 | < .001 | 0.509 |
| CPM | 0.05 | 1 | 0.05 | 0.267 | 0.607 | 0.003 |
| Residuals | 16.705 | 90 | 0.186 |  |  |  |
| Condition | 0.01 | 2 | 0.005 | 0.157 | 0.855 | 0.002 |
| Condition \* Age Group | 0.494 | 4 | 0.124 | 3.744 | 0.006 | 0.077 |
| Condition \* CPM | 0.005 | 2 | 0.003 | 0.078 | 0.925 | 8.701× 10-4 |
| Residuals | 5.941 | 180 | 0.033 |  |  |  |
| Trial Type | 0.005 | 1 | 0.005 | 0.684 | 0.41 | 0.008 |
| Trial Type \* Age Group | 0.046 | 2 | 0.023 | 3.215 | 0.045 | 0.067 |
| Trial Type \* CPM | 0.007 | 1 | 0.007 | 0.93 | 0.337 | 0.01 |
| Residuals | 0.643 | 90 | 0.007 |  |  |  |
| Condition \* Trial Type | 0.01 | 2 | 0.005 | 1.462 | 0.235 | 0.016 |
| Condition \* Trial Type \* Age Group | 0.017 | 4 | 0.004 | 1.201 | 0.312 | 0.026 |
| Condition \* Trial Type \* CPM | 0.012 | 2 | 0.006 | 1.693 | 0.187 | 0.018 |
| Residuals | 0.625 | 180 | 0.003 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

CPM: Colored Progressive Matrices

 ANOVA with error rates as the dependent measure revealed that CPM did not significantly affected error rates *F*(1, 90) = 2.415; *p* = 0.124, *ƞ2p* = 0.026. The main effect of Age group was significant *F*(2, 90) = 19.42; *p* < 0.001, *ƞ2p* = 0.301. The interaction between CPM and other independent variables were not significant in error rate analysis. Interactions between Age Group and Condition *F*(4, 180) = 11.09; *p* < 0.001, *ƞ2p* = 0.198, Age Group and Trial Type *F*(2, 90) = 11.864; *p* < 0.001, *ƞ2p* = 0.209 and Age Group, Condition and Trial Type *F*(4, 180) = 4.779; *p* = 0.001, *ƞ2p* = 0.096 were significant.

**Table S10**

*Three-way ANOVA with Error Rates as dependent variable and fluid intelligence (CPM) as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 0.561 | 2 | 0.28 | 19.42 | < .001 | 0.301 |
| CPM | 0.035 | 1 | 0.035 | 2.415 | 0.124 | 0.026 |
| Residuals | 1.299 | 90 | 0.014 |  |  |  |
| Condition | 0.011 | 2 | 0.005 | 1.122 | 0.328 | 0.012 |
| Condition \* Age Group | 0.216 | 4 | 0.054 | 11.09 | < .001 | 0.198 |
| Condition \* CPM | 0.005 | 2 | 0.003 | 0.534 | 0.587 | 0.006 |
| Residuals | 0.876 | 180 | 0.005 |  |  |  |
| Trial Type | 0.022 | 1 | 0.022 | 4.759 | 0.032 | 0.05 |
| Trial Type \* Age Group | 0.111 | 2 | 0.056 | 11.864 | < .001 | 0.209 |
| Trial Type \* CPM | 0.009 | 1 | 0.009 | 1.838 | 0.179 | 0.02 |
| Residuals | 0.421 | 90 | 0.005 |  |  |  |
| Condition \* Trial Type | 0.013 | 2 | 0.007 | 1.948 | 0.146 | 0.021 |
| Condition \* Trial Type \* Age Group | 0.066 | 4 | 0.016 | 4.779 | 0.001 | 0.096 |
| Condition \* Trial Type \* CPM | 0.008 | 2 | 0.004 | 1.235 | 0.293 | 0.014 |
| Residuals | 0.618 | 180 | 0.003 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

CPM: Colored Progressive Matrices

 ANOVA with LISAS as the dependent measure revealed that CPM did not significantly affected LISAS *F*(1, 90) = 0.623; *p* = 0.432, *ƞ2p* = 0.007. The main effect of Age Group was significant *F*(2, 90) = 54.656; *p* < 0.001, *ƞ2p* = 0.548. The interaction between CPM and other independent variables were not significant in LISAS analysis. Interaction between Age Group and Trial Type *F*(2, 90) = 6.303; *p* = 0.003, *ƞ2p* = 0.123 was significant.

**Table S11**

*Three-way ANOVA with LISAS as dependent variable and fluid intelligence (CPM) as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 21.767 | 2 | 10.883 | 54.656 | < .001 | 0.548 |
| CPM | 0.124 | 1 | 0.124 | 0.623 | 0.432 | 0.007 |
| Residuals | 17.921 | 90 | 0.199 |  |  |  |
| Condition | 0.008 | 2 | 0.004 | 0.116 | 0.891 | 0.001 |
| Condition \* Age Group | 0.3 | 4 | 0.075 | 2.174 | 0.074 | 0.046 |
| Condition \* CPM | 0.015 | 2 | 0.008 | 0.222 | 0.801 | 0.002 |
| Residuals | 6.209 | 180 | 0.034 |  |  |  |
| Trial Type | 3.721×10-5 | 1 | 3.721×10-5 | 0.004 | 0.952 | 3.971×10-5 |
| Trial Type \* Age Group | 0.131 | 2 | 0.066 | 6.303 | 0.003 | 0.123 |
| Trial Type \* CPM | 0.002 | 1 | 0.002 | 0.204 | 0.653 | 0.002 |
| Residuals | 0.937 | 90 | 0.01 |  |  |  |
| Condition \* Trial Type | 0.028 | 2 | 0.014 | 2.473 | 0.087 | 0.027 |
| Condition \* Trial Type \* Age Group | 0.025 | 4 | 0.006 | 1.121 | 0.348 | 0.024 |
| Condition \* Trial Type \* CPM | 0.027 | 2 | 0.013 | 2.367 | 0.097 | 0.026 |
| Residuals | 1.012 | 180 | 0.006 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

CPM: Colored Progressive Matrices

ANOVA with IES as the dependent measure revealed that CPM did not significantly affected IES *F*(1, 78) = 1.319; *p* = 0.254, *ƞ2p* = 0.017. The main effects of Age Group *F*(2, 78) = 5.966; *p* = 0.004, *ƞ2p* = 0.133 and Condition *F*(2, 156) = 4.599; *p* = 0.011, *ƞ2p* = 0.056 were significant. The interaction between CPM and other independent variables were not significant in IES analysis, except for the interaction between Condition and CPM *F*(2, 156) = 3.401; *p* = 0.036, *ƞ2p* = 0.042. Interaction between Condition and Age Group *F*(4, 156) = 2.779; *p* = 0.029, *ƞ2p* = 0.067 was significant.

**Table S12**

*Three-way ANOVA with IES as dependent variable and fluid intelligence (CPM) as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| CPM  | 1.166 | 1 | 1.166 | 1.319 | 0.254 | 0.017 |  |
| Age Group | 10.543 | 2 | 5.271 | 5.966 | 0.004 | 0.133 |  |
| Residuals | 68.921 | 78 | 0.884 |  |  |  |  |
| Condition | 5.954 | 2 | 2.977 | 4.599 | 0.011 | 0.056 |
| Condition \* CPM | 4.403 | 2 | 2.202 | 3.401 | 0.036 | 0.042 |
| Condition \* Age Group | 7.196 | 4 | 1.799 | 2.779 | 0.029 | 0.067 |
| Residuals | 100.978 | 156 | 0.647 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

CPM: Colored Progressive Matrices

*Socio-economic status (SES) as covariate*

A three-way ANOVA with age (5, 6-8 and 9-11 years), condition (Proactive Impossible Condition, Proactive Possible Condition and Proactive Encouraged Condition), and trial type (Switch and Repeat) was performed with log-transformed RTs as the dependent measure and SES score as covariate. The main effect of SES was not found to be significant *F*(1, 90) = 0.166; *p* = 0.685 , *ƞ2p* = 0.002, whereas the main effect of Age Group was significant *F*(2, 90) = 52.253; *p* < 0.001, *ƞ2p* = 0.537. The interaction between SES and other independent variables were not significant in RT analysis. Interaction between Age Group and Condition was significant *F*(4, 180) = 4.359; *p* = 0.002, *ƞ2p* = 0.088.

**Table S13**

*Three-way ANOVA with Reaction Time (RT) as dependent variable and SES as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 19.42 | 2 | 9.71 | 52.253 | < .001 | 0.537 |
| SES | 0.031 | 1 | 0.031 | 0.166 | 0.685 | 0.002 |
| Residuals | 16.724 | 90 | 0.186 |  |  |  |
| Condition | 0.101 | 2 | 0.05 | 1.54 | 0.217 | 0.017 |
| Condition \* Age Group | 0.57 | 4 | 0.142 | 4.359 | 0.002 | 0.088 |
| Condition \* SES | 0.064 | 2 | 0.032 | 0.981 | 0.377 | 0.011 |
| Residuals | 5.882 | 180 | 0.033 |  |  |  |
| Trial Type | 0.004 | 1 | 0.004 | 0.617 | 0.434 | 0.007 |
| Trial Type \* Age Group | 0.04 | 2 | 0.02 | 2.769 | 0.068 | 0.058 |
| Trial Type \* SES | 0.002 | 1 | 0.002 | 0.221 | 0.639 | 0.002 |
| Residuals | 0.648 | 90 | 0.007 |  |  |  |
| Condition \* Trial Type | 0.003 | 2 | 0.002 | 0.488 | 0.614 | 0.005 |
| Condition \* Trial Type \* Age Group | 0.014 | 4 | 0.003 | 0.966 | 0.427 | 0.021 |
| Condition \* Trial Type \* SES | 0.004 | 2 | 0.002 | 0.508 | 0.602 | 0.006 |
| Residuals | 0.633 | 180 | 0.004 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

SES: Socio-economic Status

 ANOVA with error rates as the dependent measure revealed that SES did not significantly affected error rates *F*(1, 90) = 0.191; *p* = 0.663, *ƞ2p* = 0.002. The main effect of Age group was significant *F*(2, 90) = 28.843; *p* < 0.001, *ƞ2p* = 0.346. The interaction between CPM and other independent variables were not significant in error rate analysis. Interactions between Age Group and Condition *F*(4, 180) = 12.214; *p* < 0.001, *ƞ2p* = 0.213, Age Group and Trial Type *F*(2, 90) = 15.504; *p* < 0.001, *ƞ2p* = 0.256 and Age Group, Condition and Trial Type *F*(4, 180) = 6.059; *p* < 0.001, *ƞ2p* = 0.119 were significant.

**Table S14**

*Three-way ANOVA with Error Rates as dependent variable and SES as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 0.705 | 2 | 0.353 | 23.843 | < .001 | 0.346 |
| SES | 0.003 | 1 | 0.003 | 0.191 | 0.663 | 0.002 |
| Residuals | 1.331 | 90 | 0.015 |  |  |  |
| Condition | 0.022 | 2 | 0.011 | 2.302 | 0.103 | 0.025 |
| Condition \* Age Group | 0.239 | 4 | 0.06 | 12.214 | < .001 | 0.213 |
| Condition \* SES | 0.001 | 2 | 5.715×10-4 | 0.117 | 0.89 | 0.001 |
| Residuals | 0.88 | 180 | 0.005 |  |  |  |
| Trial Type | 0.002 | 1 | 0.002 | 0.381 | 0.539 | 0.004 |
| Trial Type \* Age Group | 0.145 | 2 | 0.072 | 15.504 | < .001 | 0.256 |
| Trial Type \* SES | 0.009 | 1 | 0.009 | 2.029 | 0.158 | 0.022 |
| Residuals | 0.42 | 90 | 0.005 |  |  |  |
| Condition \* Trial Type | 0.003 | 2 | 0.002 | 0.441 | 0.644 | 0.005 |
| Condition \* Trial Type \* Age Group | 0.083 | 4 | 0.021 | 6.059 | < .001 | 0.119 |
| Condition \* Trial Type \* SES | 0.011 | 2 | 0.005 | 1.565 | 0.212 | 0.017 |
| Residuals | 0.616 | 180 | 0.003 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

SES: Socio-economic Status

 ANOVA with LISAS as the dependent measure revealed that SES did not significantly affected LISAS *F*(1, 90) = 0.154; *p* = 0.695, *ƞ2p* = 0.002. The main effect of Age Group was significant *F*(2, 90) = 61.794; *p* < 0.001, *ƞ2p* = 0.579. The interaction between CPM and other independent variables were not significant in LISAS analysis. Interactions between Condition and Age Group *F*(4, 180) = 2.803; *p* = 0.027, *ƞ2p* = 0.059 and Age Group and Trial Type *F*(2, 90) = 6.371; *p* = 0.003, *ƞ2p* = 0.124 were significant.

**Table S15**

*Three-way ANOVA with LISAS as dependent variable and SES as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group | 24.737 | 2 | 12.369 | 61.794 | < .001 | 0.579 |
| SES | 0.031 | 1 | 0.031 | 0.154 | 0.695 | 0.002 |
| Residuals | 18.014 | 90 | 0.2 |  |  |  |
| Condition | 0.071 | 2 | 0.035 | 1.04 | 0.356 | 0.011 |
| Condition \* Age Group | 0.382 | 4 | 0.096 | 2.803 | 0.027 | 0.059 |
| Condition \* SES | 0.09 | 2 | 0.045 | 1.322 | 0.269 | 0.014 |
| Residuals | 6.134 | 180 | 0.034 |  |  |  |
| Trial Type | 0.008 | 1 | 0.008 | 0.775 | 0.381 | 0.009 |
| Trial Type \* Age Group | 0.133 | 2 | 0.066 | 6.371 | 0.003 | 0.124 |
| Trial Type \* SES | 4.560×10-5 | 1 | 4.560×10-5 | 0.004 | 0.947 | 4.855×10-5 |
| Residuals | 0.939 | 90 | 0.01 |  |  |  |
| Condition \* Trial Type | 0.004 | 2 | 0.002 | 0.331 | 0.719 | 0.004 |
| Condition \* Trial Type \* Age Group | 0.029 | 4 | 0.007 | 1.252 | 0.291 | 0.027 |
| Condition \* Trial Type \* SES | 9.574×10-4 | 2 | 4.787×10-4 | 0.083 | 0.92 | 9.215×10-4 |
| Residuals | 1.038 | 180 | 0.006 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

Trial type: Switch and Repeat trials

SES: Socio-economic Status

 ANOVA with IES as the dependent measure revealed that SES did not significantly affected IES *F*(1, 78) = 2.814; *p* = 0.097, *ƞ2p* = 0.035. The main effect of Age Group *F*(2, 78) = 7.66; *p* < 0.001, *ƞ2p* = 0.164 was significant. The interaction between CPM and other independent variables were not significant in IES analysis. Interaction between Condition and Age Group *F*(4, 156) = 3.418; *p* = 0.01, *ƞ2p* = 0.081 was significant.

**Table S16**

*Three-way ANOVA with IES as dependent variable and SES as covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cases** | **Sum of Squares** | **df** | **Mean Square** | **F** | ***p*** | ***η²p*** |
| Age Group  | 13.286 | 2 | 6.643 | 7.66 | < .001 | 0.164 |  |
| SES | 2.44 | 1 | 2.44 | 2.814 | 0.097 | 0.035 |  |
| Residuals | 67.647 | 78 | 0.867 |  |  |  |  |
| Condition | 0.871 | 2 | 0.436 | 0.646 | 0.525 | 0.008 |
| Condition \* Age Group | 9.216 | 4 | 2.304 | 3.418 | 0.01 | 0.081 |
| Condition \* SES | 0.216 | 2 | 0.108 | 0.16 | 0.852 | 0.002 |
| Residuals | 105.165 | 156 | 0.674 |  |  |  |

*Note:*

Age Group: 5, 6-8, and 9-11-year-olds

Experimental conditions: Proactive Impossible Condition (PIC), Proactive Possible Condition (PPC), and Proactive Encouraged Condition (PEC)

*SES: Socio-economic Status*