

# The Long and Winding Road to Real-Life Experiments: Remote Assessment of Executive Functions with Computerized Games—Results from 8 Years of Naturalistic Interventions

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## Section 2.1. Participants and procedure.

**Table S1.** Detailed description of the interventions included in the study and the participants that took part in each one of them.

[illegible]

(cont. Table S1)

|    |               |         |   |             |           |    |                                               |
|----|---------------|---------|---|-------------|-----------|----|-----------------------------------------------|
| 4  | 2016, April   | Uruguay | 5 | 5.41 (0.28) | 0.44 (11) | 25 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 5  | 2016, April   | Uruguay | 5 | 5.42 (0.27) | 0.46 (13) | 28 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 6  | 2016, April   | Uruguay | 5 | 5.26 (0.34) | 0.43 (9)  | 21 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 7  | 2016, April   | Uruguay | 5 | 5.09 (0.48) | 0.34 (10) | 29 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 8  | 2016, October | Uruguay | 5 | 5.88 (0.28) | 0.41 (7)  | 17 | Stroop<br>Corsi<br>ToNI<br>ToL**              |
| 9  | 2016, October | Uruguay | 5 | 5.86 (0.25) | 0.45 (9)  | 20 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 10 | 2016, October | Uruguay | 5 | 5.90 (0.31) | 0.43 (9)  | 21 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 11 | 2017, April   | Uruguay | 5 | 5.20 (0.47) | 0.47 (7)  | 15 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 12 | 2017, April   | Uruguay | 5 | 5.33 (0.30) | 0.68 (13) | 19 | Stroop<br>Corsi<br>ToNI*<br>ToL**             |
| 13 | 2020          | Spain   | 5 | 5.61 (0.28) | 0.4 (10)  | 25 | Child-ANT<br>Stroop<br>Corsi<br>ToNI*<br>ToL* |
| 14 | 2020          | Spain   | 5 | 5.55 (0.33) | 0.4 (10)  | 25 | Child-ANT<br>Stroop<br>Corsi<br>ToNI*<br>ToL* |

(cont. in next page)

cont. Table S1

|    |      |           |   |                 |           |    |                                               |
|----|------|-----------|---|-----------------|-----------|----|-----------------------------------------------|
| 15 | 2021 | Spain     | 4 | 4.35 (0.29)     | 0.60 (14) | 23 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL * |
| 16 | 2021 | Spain     | 4 | 4.34 (0.30)     | 0.62 (13) | 21 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL * |
| 17 | 2021 | Spain     | 4 | 4.32 (0.29)     | 0.47 (9)  | 19 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL * |
| 18 | 2021 | Spain     | 4 | 4.25 (0.24)     | 0.5 (10)  | 20 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL * |
| 19 | 2021 | Argentina | 7 | 7.9 (0.41)      | 0.35 (7)  | 20 | Child-ANT<br>Stroop<br>Corsi<br>ToNI          |
| 20 | 2021 | Argentina | 8 | 8.79 (0.48)     | 0.65 (11) | 17 | Child-ANT<br>Stroop<br>Corsi<br>ToNI          |
| 21 | 2022 | Argentina | 7 | 7.40 (0.30)     | 0.3 (6)   | 20 | Child-ANT<br>Stroop<br>Corsi<br>ToNI          |
| 22 | 2023 | Spain     | 4 | 4.56 (0.29)     | (25)      | 42 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL   |
| 23 | 2023 | Spain     | 4 | Missing<br>data | (11)      | 23 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL   |
| 24 | 2023 | Spain     | 4 | 4.64 (0.28)     | (20)      | 49 | Child-ANT<br>Stroop<br>Corsi<br>ToNI<br>ToL   |

\* Missing RT data

\*\* RT data incomplete

### Section 2.2.1. Description of the time-unconstrained tasks

#### ToNI – 4 task

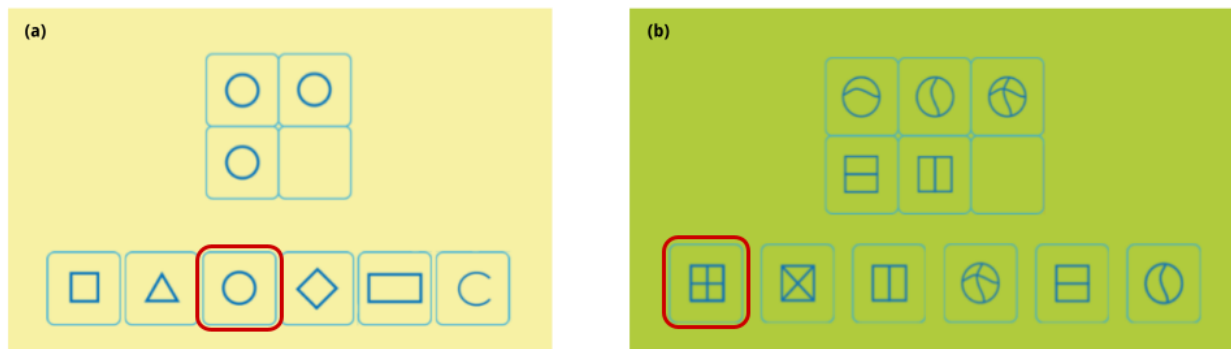


**Figure S1.** Two example trials from the adaptation of the ToNI task with different cognitive demands. In both examples the stimulus set is shown above, while the set of options is below. (a) The player must recognize that the relation between the figures in the stimulus set is that they are all the same geometric shape (circle) and choose, from the set of options, the missing figure that follows that logic (correct response is highlighted in red). (b) In this harder trial, the player must recognize that the bottom 3 drawings in the stimulus set must follow the same logic as the top 3: having the same geometric shape and following the same sequence of lines. To fulfil this, the missing drawing must be a square and have two perpendicular lines (correct response is highlighted in red).

#### Tower of London task

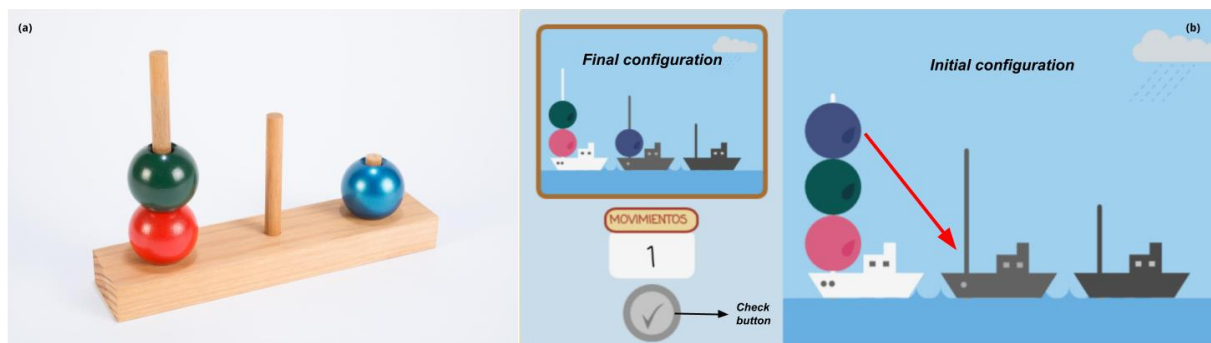


**Figure S2.** Original manual display and computerized version of the Tower of London task. (a) Wooden artefact used for the original version of this assessment. (b) Detailed screenshot of a trial from the computerized gamified version of the test. On the screen, the final configuration to be achieved is observed on the upper left, while the initial configuration that needs to be modified to reach the final configuration appears on the right. The check button that the player must press when they finished the trial is on the bottom left, indicated with an arrow. The desired number of movements is indicated below the final configuration (moving only one ball is sufficient to solve this trial). The figure also shows the different lengths of the rods, which can hold different number of balls: the shortest one, only one ball, the middle, two, and the longest one holds all three.

## Section 2.2.2. Description of the time-constrained tasks

### Child Attentional Networks Task

The Child Attentional Network Test (Child-ANT), an adaptation of its adult counterpart by Rueda and colleagues [1], was developed to evaluate three fundamental aspects of attentional processing in children, typically up to the age of around ten y.o- These aspects include alertness, orientation, and executive control. The task requires children to determine whether a central animal is pointing to the right or to the left and, then, signify their choice by pressing the corresponding arrow on the screen (highlighted in red in Figure S3(a)). Each trial in this test follows a specific sequence, as depicted in Figure 4 (main manuscript).

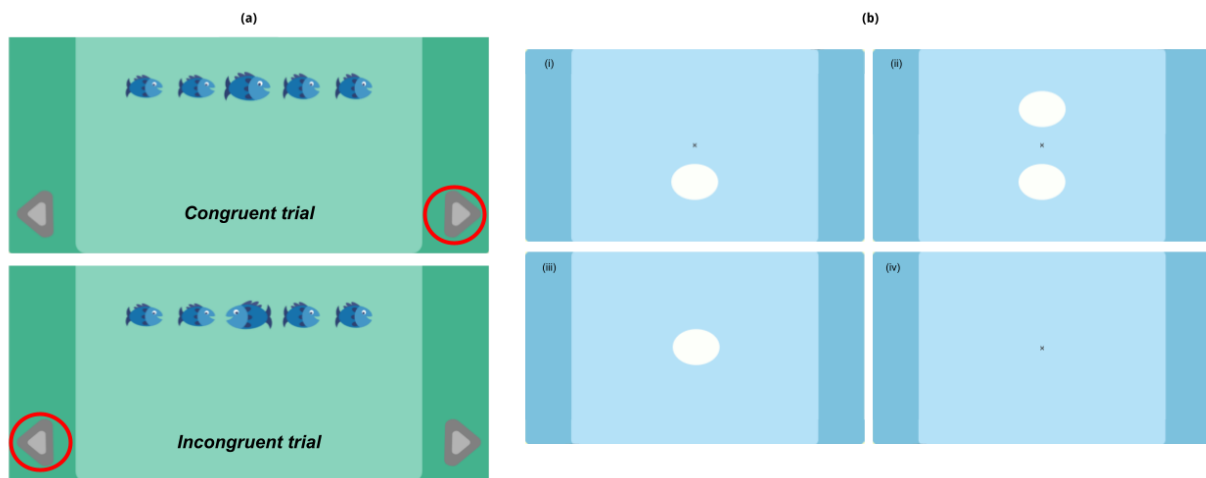


**Figure S3.** Captures of the Child-ANT task version. (a) Screenshots of test trials. Above, a congruent trial, in which all animals look in the same direction. Below, an incongruent trial in which the central animal looks in the opposite direction to the flanking animals. The correct response in both trials is the button marked in red. (b) Screenshots of the visual cues that appear before the target. (i) Spatial cue (in this case, below), (ii) Double cue, (iii) Central cue, (iv) Trial without a cue.

In 75% of the trials conducted, the screen presents one of three spatial cues 150 msec before displaying the animals. These cues fall into three categories: a) cues positioned in the same place where the target would appear, either above or below the center of the screen ('spatial'), b) cues positioned both above and below the center of the screen ('double'), or c) cues positioned at the center of the screen ('central') (referred to as (i), (ii), and (iii) respectively in Figure S3(b)). The remaining 25% of trials do not include any cues (referred to as (iv)). It's important to note that these cues are never explicitly explained to the children. The spatial cue (i) is strategically placed where the central animal will appear, effectively directing the player's focus to that particular location. This cue provides clear guidance regarding where the player should concentrate his/her attention. In contrast, the double cue (ii) serves as an alert that a stimulus is imminent, but doesn't offer any specific information about its exact screen position. The purpose of these trials is to investigate whether the response differs when participants are alerted about an impending stimulus compared to trials without cues. This component helps assess the alerting attention network. The central cue (iii), much like the double cue, does not indicate the stimulus's position. Instead, it functions as a 'useless' spatial cue. Comparing trials with central cue to trials with a spatial cue that effectively indicates the animal's position allows to estimate the orienting attention network. This helps determine if the presence of a spatial cue, even if it doesn't provide relevant information, affects performance.

### Heart-Flower Stroop task

This adapted Stroop task (the Heart-Flower Stroop), developed by Davidson and collaborators [2], serves as an assessment tool for measuring inhibitory control and cognitive flexibility in children. In this task, participants are required to press one of two buttons based on the appearance and position of visual stimuli presented in the screen. An example of a trial is depicted in Figure S4..

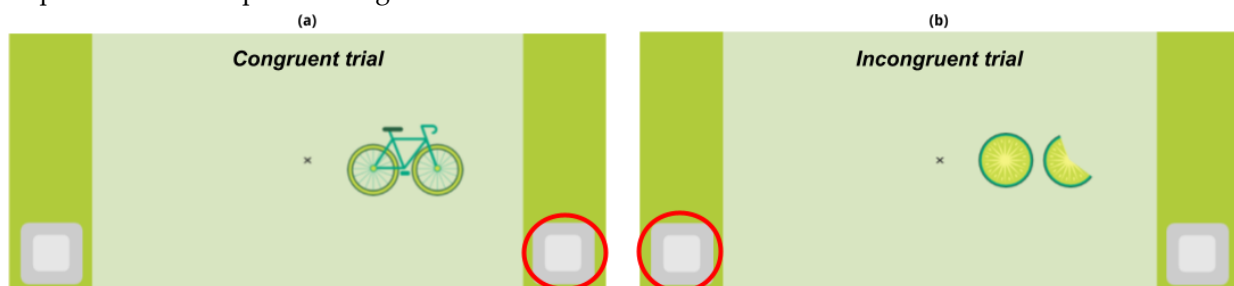


**Figure S4.** A summary of the Heart-Flower Stroop task used along the interventions. (a) congruent stimuli; (b) incongruent stimuli. In both cases, the correct answer is shown in red.

### Section 2.4.1. Data cleansing process and descriptive statistics

We performed a correlation analysis with all the outcome variables resulting from the interventions. For the time-constrained tasks, however, we decided to only include performance on the incongruent trials. In the full analysis for both tasks (child-ANT and Heart-Flower Stroop) we do compare congruent to incongruent trials, but for this descriptive plot comparing both trial types within each evaluation is out of the scope.

### Section 3.1. Descriptive statistics



**Figure S5.** Correlation between outcome measures related to the three attentional networks measured with the child-ANT task.

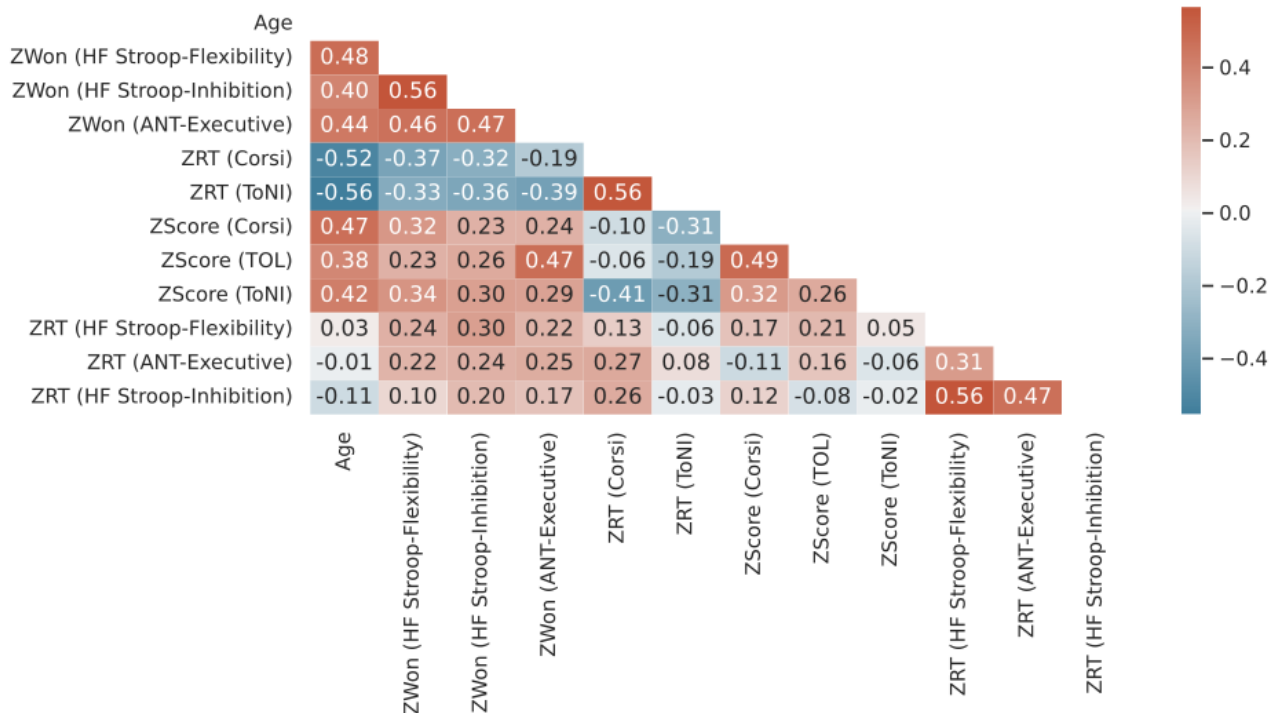


**Figure S6.** Heatmap depicting zero-order correlation between all outcome measurements (except for the Orientation and Alerting networks). Order is based on the correlation to the Age variable (cont).

**Table S2.** Bivariate correlations between all outcome variables and Age. Last column represents FDR corrected p-values.

| Variable 1           | Variable 2                   | Correlation | p-value   | P-value (corrected) |
|----------------------|------------------------------|-------------|-----------|---------------------|
| Age                  | ZScore (Corsi)               | 0.47        | 1.441E-24 | <b>2.377E-23</b>    |
| Age                  | ZRT (Corsi)                  | -0.52       | 2.787E-30 | <b>1.840E-28</b>    |
| Age                  | ZWon (HF Stroop-Inhibition)  | 0.4         | 4.905E-14 | <b>3.237E-13</b>    |
| Age                  | ZRT (HF Stroop-Inhibition)   | -0.11       | 4.836E-02 | 6.138E-02           |
| Age                  | ZWon (HF Stroop-Flexibility) | 0.48        | 4.360E-18 | <b>3.597E-17</b>    |
| Age                  | ZRT (HF Stroop-Flexibility)  | 0.03        | 6.437E-01 | 6.744E-01           |
| Age                  | ZWon (ANT-Executive)         | 0.44        | 9.985E-13 | <b>5.492E-12</b>    |
| Age                  | ZRT (ANT-Executive)          | -0.01       | 8.248E-01 | 8.248E-01           |
| Age                  | ZScore (ToNI)                | 0.42        | 4.804E-19 | <b>4.530E-18</b>    |
| Age                  | ZRT (ToNI)                   | -0.56       | 1.628E-19 | <b>2.149E-18</b>    |
| Age                  | ZScore (TOL)                 | 0.38        | 8.206E-09 | <b>2.850E-08</b>    |
| ZScore (Corsi)       | ZRT (Corsi)                  | -0.1        | 2.094E-02 | <b>2.880E-02</b>    |
| ZScore (Corsi)       | ZWon (HF Stroop-Inhibition)  | 0.23        | 2.566E-05 | <b>4.981E-05</b>    |
| ZScore (Corsi)       | ZRT (HF Stroop-Inhibition)   | 0.12        | 3.983E-02 | 5.154E-02           |
| ZScore (Corsi)       | ZWon (HF Stroop-Flexibility) | 0.32        | 3.350E-08 | <b>1.005E-07</b>    |
| ZScore (Corsi)       | ZRT (HF Stroop-Flexibility)  | 0.17        | 4.198E-03 | <b>6.156E-03</b>    |
| (cont. in next page) |                              |             |           |                     |

| (cont. Table S2)             |                              |       |           |                  |
|------------------------------|------------------------------|-------|-----------|------------------|
| ZScore (Corsi)               | ZWon (ANT-Executive)         | 0.24  | 7.893E-05 | <b>1.408E-04</b> |
| ZScore (Corsi)               | ZRT (ANT-Executive)          | -0.11 | 6.570E-02 | 8.182E-02        |
| ZScore (Corsi)               | ZScore (ToNI)                | 0.32  | 1.830E-10 | <b>7.548E-10</b> |
| ZScore (Corsi)               | ZRT (ToNI)                   | -0.31 | 2.237E-06 | <b>5.469E-06</b> |
| ZScore (Corsi)               | ZScore (TOL)                 | 0.49  | 3.233E-13 | <b>1.940E-12</b> |
| ZRT (Corsi)                  | ZWon (HF Stroop-Inhibition)  | -0.32 | 4.923E-09 | <b>1.805E-08</b> |
| ZRT (Corsi)                  | ZRT (HF Stroop-Inhibition)   | 0.26  | 3.882E-06 | <b>9.151E-06</b> |
| ZRT (Corsi)                  | ZWon (HF Stroop-Flexibility) | -0.37 | 1.335E-10 | <b>5.872E-10</b> |
| ZRT (Corsi)                  | ZRT (HF Stroop-Flexibility)  | 0.13  | 2.851E-02 | <b>3.841E-02</b> |
| ZRT (Corsi)                  | ZWon (ANT-Executive)         | -0.19 | 1.812E-03 | <b>2.917E-03</b> |
| ZRT (Corsi)                  | ZRT (ANT-Executive)          | 0.27  | 8.107E-06 | <b>1.687E-05</b> |
| ZRT (Corsi)                  | ZScore (ToNI)                | -0.41 | 1.055E-16 | <b>7.739E-16</b> |
| ZRT (Corsi)                  | ZRT (ToNI)                   | 0.56  | 4.199E-19 | <b>4.530E-18</b> |
| ZRT (Corsi)                  | ZScore (TOL)                 | -0.06 | 4.065E-01 | 4.471E-01        |
| ZWon (HF Stroop-Inhibition)  | ZRT (HF Stroop-Inhibition)   | 0.2   | 1.351E-04 | <b>2.346E-04</b> |
| ZWon (HF Stroop-Inhibition)  | ZWon (HF Stroop-Flexibility) | 0.56  | 4.499E-25 | <b>9.897E-24</b> |
| ZWon (HF Stroop-Inhibition)  | ZRT (HF Stroop-Flexibility)  | 0.3   | 2.548E-07 | <b>7.008E-07</b> |
| ZWon (HF Stroop-Inhibition)  | ZWon (ANT-Executive)         | 0.47  | 2.595E-12 | <b>1.318E-11</b> |
| ZWon (HF Stroop-Inhibition)  | ZRT (ANT-Executive)          | 0.24  | 8.056E-04 | <b>1.329E-03</b> |
| ZWon (HF Stroop-Inhibition)  | ZScore (ToNI)                | 0.3   | 1.573E-07 | <b>4.514E-07</b> |
| ZWon (HF Stroop-Inhibition)  | ZRT (ToNI)                   | -0.36 | 5.551E-07 | <b>1.466E-06</b> |
| ZWon (HF Stroop-Inhibition)  | ZScore (TOL)                 | 0.26  | 3.593E-03 | <b>5.646E-03</b> |
| ZRT (HF Stroop-Inhibition)   | ZWon (HF Stroop-Flexibility) | 0.1   | 9.577E-02 | 1.149E-01        |
| ZRT (HF Stroop-Inhibition)   | ZRT (HF Stroop-Flexibility)  | 0.56  | 3.540E-25 | <b>9.897E-24</b> |
| ZRT (HF Stroop-Inhibition)   | ZWon (ANT-Executive)         | 0.17  | 1.523E-02 | <b>2.185E-02</b> |
| ZRT (HF Stroop-Inhibition)   | ZRT (ANT-Executive)          | 0.47  | 4.157E-12 | <b>1.960E-11</b> |
| ZRT (HF Stroop-Inhibition)   | ZScore (ToNI)                | -0.02 | 7.220E-01 | 7.331E-01        |
| ZRT (HF Stroop-Inhibition)   | ZRT (ToNI)                   | -0.03 | 7.110E-01 | 7.331E-01        |
| ZRT (HF Stroop-Inhibition)   | ZScore (TOL)                 | -0.08 | 3.761E-01 | 4.207E-01        |
| ZWon (HF Stroop-Flexibility) | ZRT (HF Stroop-Flexibility)  | 0.24  | 1.876E-05 | <b>3.751E-05</b> |
| ZWon (HF Stroop-Flexibility) | ZWon (ANT-Executive)         | 0.46  | 4.943E-10 | <b>1.919E-09</b> |
| ZWon (HF Stroop-Flexibility) | ZRT (ANT-Executive)          | 0.22  | 3.797E-03 | <b>5.828E-03</b> |
| ZWon (HF Stroop-Flexibility) | ZScore (ToNI)                | 0.34  | 2.882E-08 | <b>9.058E-08</b> |
| ZWon (HF Stroop-Flexibility) | ZRT (ToNI)                   | -0.33 | 3.066E-05 | <b>5.782E-05</b> |
| ZWon (HF Stroop-Flexibility) | ZScore (TOL)                 | 0.23  | 1.564E-02 | <b>2.196E-02</b> |
| (cont. in next page)         |                              |       |           |                  |

| (cont. Table S2)            |                      |       |           |                  |
|-----------------------------|----------------------|-------|-----------|------------------|
| ZRT (HF Stroop-Flexibility) | ZWon (ANT-Executive) | 0.22  | 4.018E-03 | <b>6.026E-03</b> |
| ZRT (HF Stroop-Flexibility) | ZRT (ANT-Executive)  | 0.31  | 4.059E-05 | <b>7.442E-05</b> |
| ZRT (HF Stroop-Flexibility) | ZScore (ToNI)        | 0.05  | 4.574E-01 | 4.949E-01        |
| ZRT (HF Stroop-Flexibility) | ZRT (ToNI)           | -0.06 | 4.905E-01 | 5.222E-01        |
| ZRT (HF Stroop-Flexibility) | ZScore (TOL)         | 0.21  | 3.237E-02 | <b>4.273E-02</b> |
| ZWon (ANT-Executive)        | ZRT (ANT-Executive)  | 0.25  | 8.177E-06 | <b>1.687E-05</b> |
| ZWon (ANT-Executive)        | ZScore (ToNI)        | 0.29  | 5.470E-06 | <b>1.245E-05</b> |
| ZWon (ANT-Executive)        | ZRT (ToNI)           | -0.39 | 1.789E-08 | <b>5.905E-08</b> |
| ZWon (ANT-Executive)        | ZScore (TOL)         | 0.47  | 7.979E-06 | <b>1.687E-05</b> |
| ZRT (ANT-Executive)         | ZScore (ToNI)        | -0.06 | 3.463E-01 | 3.941E-01        |
| ZRT (ANT-Executive)         | ZRT (ToNI)           | 0.08  | 2.759E-01 | 3.195E-01        |
| ZRT (ANT-Executive)         | ZScore (TOL)         | 0.16  | 1.429E-01 | 1.684E-01        |
| ZScore (ToNI)               | ZRT (ToNI)           | -0.31 | 1.240E-06 | <b>3.147E-06</b> |
| ZScore (ToNI)               | ZScore (TOL)         | 0.26  | 1.929E-04 | <b>3.264E-04</b> |
| ZRT (ToNI)                  | ZScore (TOL)         | -0.19 | 9.429E-02 | 1.149E-01        |

**Table S3.** Bivariate correlations between all outcome variables controlling for age. In bold, FDR corrected significant p-values.

| Variable 1           | Variable 2                   | Partial Correlation | p-value   | P-value (corrected) |
|----------------------|------------------------------|---------------------|-----------|---------------------|
| ZScore (Corsi)       | ZRT (Corsi)                  | 0.05                | 3.092E-01 | 4.360E-01           |
| ZScore (Corsi)       | ZWon (HF Stroop-Inhibition)  | 0.06                | 3.437E-01 | 4.501E-01           |
| ZScore (Corsi)       | ZRT (HF Stroop-Inhibition)   | 0.13                | 2.308E-02 | <b>5.290E-02</b>    |
| ZScore (Corsi)       | ZWon (HF Stroop-Flexibility) | 0.03                | 5.826E-01 | 6.817E-01           |
| ZScore (Corsi)       | ZRT (HF Stroop-Flexibility)  | 0.09                | 1.591E-01 | 2.747E-01           |
| ZScore (Corsi)       | ZWon (ANT-Executive)         | 0.18                | 7.839E-03 | <b>2.536E-02</b>    |
| ZScore (Corsi)       | ZRT (ANT-Executive)          | 0.05                | 4.733E-01 | 5.785E-01           |
| ZScore (Corsi)       | ZScore (ToNI)                | 0.18                | 7.105E-04 | <b>3.329E-03</b>    |
| ZScore (Corsi)       | ZRT (ToNI)                   | 0                   | 1.000E+00 | 1.000E+00           |
| ZScore (Corsi)       | ZScore (TOL)                 | 0.35                | 7.809E-07 | <b>8.590E-06</b>    |
| ZRT (Corsi)          | ZWon (HF Stroop-Inhibition)  | -0.16               | 6.080E-03 | <b>2.090E-02</b>    |
| ZRT (Corsi)          | ZRT (HF Stroop-Inhibition)   | 0.31                | 9.204E-08 | <b>1.265E-06</b>    |
| ZRT (Corsi)          | ZWon (HF Stroop-Flexibility) | -0.09               | 1.484E-01 | 2.747E-01           |
| ZRT (Corsi)          | ZRT (HF Stroop-Flexibility)  | 0.26                | 2.095E-05 | <b>1.646E-04</b>    |
| ZRT (Corsi)          | ZWon (ANT-Executive)         | 0.07                | 3.222E-01 | 4.430E-01           |
| ZRT (Corsi)          | ZRT (ANT-Executive)          | 0.17                | 1.389E-02 | <b>3.820E-02</b>    |
| (cont. in next page) |                              |                     |           |                     |

| <i>(cont. Table S3)</i>      |                              |       |           |                  |
|------------------------------|------------------------------|-------|-----------|------------------|
| ZRT (Corsi)                  | ZScore (ToNI)                | -0.18 | 7.896E-04 | <b>3.341E-03</b> |
| ZRT (Corsi)                  | ZRT (ToNI)                   | 0.32  | 3.972E-06 | <b>3.641E-05</b> |
| ZRT (Corsi)                  | ZScore (TOL)                 | -0.03 | 7.163E-01 | 7.577E-01        |
| ZWon (HF Stroop-Inhibition)  | ZRT (HF Stroop-Inhibition)   | 0.16  | 3.287E-03 | <b>1.205E-02</b> |
| ZWon (HF Stroop-Inhibition)  | ZWon (HF Stroop-Flexibility) | 0.45  | 8.281E-15 | <b>2.277E-13</b> |
| ZWon (HF Stroop-Inhibition)  | ZRT (HF Stroop-Flexibility)  | 0.23  | 1.462E-04 | <b>8.040E-04</b> |
| ZWon (HF Stroop-Inhibition)  | ZWon (ANT-Executive)         | 0.29  | 5.726E-05 | <b>3.936E-04</b> |
| ZWon (HF Stroop-Inhibition)  | ZRT (ANT-Executive)          | 0.19  | 1.197E-02 | <b>3.657E-02</b> |
| ZWon (HF Stroop-Inhibition)  | ZScore (ToNI)                | 0.15  | 1.310E-02 | <b>3.793E-02</b> |
| ZWon (HF Stroop-Inhibition)  | ZRT (ToNI)                   | -0.11 | 1.529E-01 | 2.747E-01        |
| ZWon (HF Stroop-Inhibition)  | ZScore (TOL)                 | 0.11  | 2.479E-01 | 3.752E-01        |
| ZRT (HF Stroop-Inhibition)   | ZWon (HF Stroop-Flexibility) | 0.05  | 4.230E-01 | 5.288E-01        |
| ZRT (HF Stroop-Inhibition)   | ZRT (HF Stroop-Flexibility)  | 0.57  | 5.643E-24 | <b>3.104E-22</b> |
| ZRT (HF Stroop-Inhibition)   | ZWon (ANT-Executive)         | 0.09  | 2.129E-01 | 3.411E-01        |
| ZRT (HF Stroop-Inhibition)   | ZRT (ANT-Executive)          | 0.44  | 3.789E-10 | <b>6.947E-09</b> |
| ZRT (HF Stroop-Inhibition)   | ZScore (ToNI)                | 0.07  | 2.170E-01 | 3.411E-01        |
| ZRT (HF Stroop-Inhibition)   | ZRT (ToNI)                   | 0.05  | 4.915E-01 | 5.877E-01        |
| ZRT (HF Stroop-Inhibition)   | ZScore (TOL)                 | -0.03 | 7.150E-01 | 7.577E-01        |
| ZWon (HF Stroop-Flexibility) | ZRT (HF Stroop-Flexibility)  | 0.14  | 1.923E-02 | <b>4.924E-02</b> |
| ZWon (HF Stroop-Flexibility) | ZWon (ANT-Executive)         | 0.27  | 7.262E-04 | <b>3.329E-03</b> |
| ZWon (HF Stroop-Flexibility) | ZRT (ANT-Executive)          | 0.19  | 1.969E-02 | <b>4.924E-02</b> |
| ZWon (HF Stroop-Flexibility) | ZScore (ToNI)                | 0.09  | 1.598E-01 | 2.747E-01        |
| ZWon (HF Stroop-Flexibility) | ZRT (ToNI)                   | -0.04 | 6.163E-01 | 7.062E-01        |
| ZWon (HF Stroop-Flexibility) | ZScore (TOL)                 | -0.01 | 9.535E-01 | 9.711E-01        |
| ZRT (HF Stroop-Flexibility)  | ZWon (ANT-Executive)         | 0.09  | 2.739E-01 | 3.965E-01        |
| ZRT (HF Stroop-Flexibility)  | ZRT (ANT-Executive)          | 0.26  | 1.297E-03 | <b>5.097E-03</b> |
| ZRT (HF Stroop-Flexibility)  | ZScore (ToNI)                | 0.03  | 6.681E-01 | 7.349E-01        |
| ZRT (HF Stroop-Flexibility)  | ZRT (ToNI)                   | 0.08  | 3.349E-01 | 4.493E-01        |
| ZRT (HF Stroop-Flexibility)  | ZScore (TOL)                 | 0.14  | 1.720E-01 | 2.867E-01        |
| ZWon (ANT-Executive)         | ZRT (ANT-Executive)          | 0.15  | 2.244E-02 | 5.290E-02        |
| ZWon (ANT-Executive)         | ZScore (ToNI)                | 0.11  | 1.001E-01 | 2.039E-01        |
| ZWon (ANT-Executive)         | ZRT (ToNI)                   | -0.13 | 7.982E-02 | 1.688E-01        |
| ZWon (ANT-Executive)         | ZScore (TOL)                 | 0.42  | 1.214E-04 | <b>7.421E-04</b> |
| ZRT (ANT-Executive)          | ZScore (ToNI)                | 0.03  | 6.366E-01 | 7.145E-01        |
| ZRT (ANT-Executive)          | ZRT (ToNI)                   | 0.11  | 1.296E-01 | 2.545E-01        |
| <i>(cont. in next page)</i>  |                              |       |           |                  |

| (cont. Table S3)    |              |       |           |           |
|---------------------|--------------|-------|-----------|-----------|
| ZRT (ANT-Executive) | ZScore (TOL) | 0.13  | 2.524E-01 | 3.752E-01 |
| ZScore (ToNI)       | ZRT (ToNI)   | -0.06 | 3.760E-01 | 4.800E-01 |
| ZScore (ToNI)       | ZScore (TOL) | 0.14  | 4.629E-02 | 1.018E-01 |
| ZRT (ToNI)          | ZScore (TOL) | -0.02 | 8.694E-01 | 9.022E-01 |

## Section 3.2. Time-unconstrained tasks

### 3.2.1. Corsi task

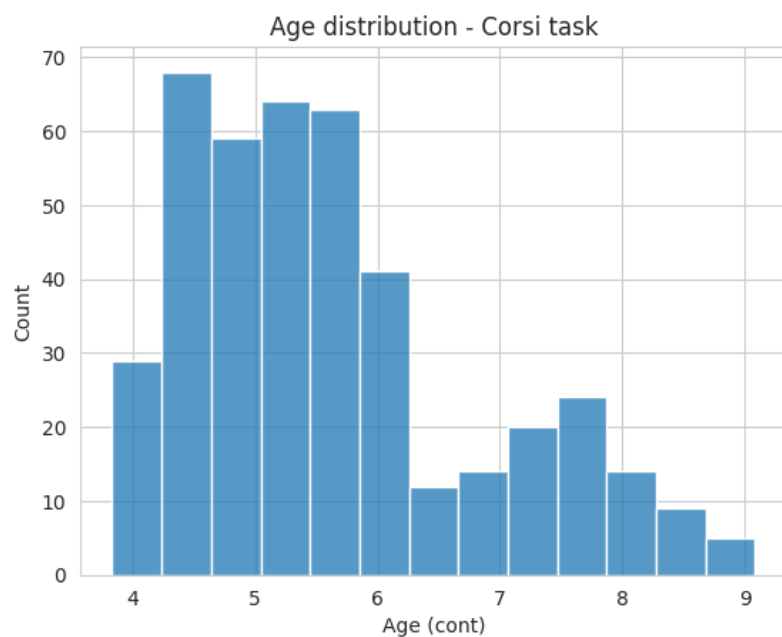


**Figure S7.** Age distribution for the participants of the Corsi task included in the analysis.

**Table S4.** Parameters for the linear mixed model with working memory Score (log) as the outcome and Age (cont) as predictor.

| Working memory Score (log) |             |            |        |                  |        |        |
|----------------------------|-------------|------------|--------|------------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | P> z             | [0.025 | 0.975] |
| (Intercept)                | -2.129      | 0.724      | -2.941 | <b>0.003</b>     | -3.548 | -0.710 |
| Age                        | 2.669       | 0.416      | 6.417  | <b>&lt;0.001</b> | 1.854  | 3.484  |
| Group Var                  | 0.178       | 0.080      |        |                  |        |        |
| Observations               | 422         |            |        |                  |        |        |
| Groups                     | 23          |            |        |                  |        |        |
| RMSE                       | 0.975       |            |        |                  |        |        |
| Marginal R <sup>2</sup>    | 0.294       |            |        |                  |        |        |
| Conditional R <sup>2</sup> | 0.423       |            |        |                  |        |        |

**Table S5.** Full model output for Score and RT (log) response variables in the Corsi Block-Tapping task. In bold the selected models and the best metric in each case.

| Score                                              |            |                                    |              |              |
|----------------------------------------------------|------------|------------------------------------|--------------|--------------|
| Models                                             | Comparison |                                    |              |              |
|                                                    | i. vs ii.  | LR: 32.55, <i>p</i> -value:1.16e-8 |              |              |
| <i>i. log(Score) ~ 1 + (1 Subset)</i>              |            | metric                             | linear       | logarithmic  |
| <b><i>ii. log(Score) ~ Age + (1 Subset)</i></b>    |            | RMSE                               | <b>0.970</b> | 0.975        |
| <i>iii. log(Score) ~ log(Age) + (1 Subset)</i>     | ii. vs iii | R <sup>2</sup> (marginal)          | <b>0.298</b> | 0.294        |
|                                                    |            | R <sup>2</sup> (conditional)       | 0.407        | <b>0.423</b> |
| RT                                                 |            |                                    |              |              |
| Models                                             | Comparison |                                    |              |              |
| For difficulty level 1:                            | i. vs ii.  | LR: 14.49, <i>p</i> -value:1.41e-4 |              |              |
| <i>i. log(RT) ~ 1 + (1 Subset)</i>                 |            | metric                             | linear       | logarithmic  |
| <i>ii. log(RT) ~ Age + (1 Subset)</i>              | ii. vs iii | - RMSE                             | 0.433        | <b>0.423</b> |
| <b><i>iii. log(RT) ~ log(Age) + (1 Subset)</i></b> |            | R <sup>2</sup> (marginal)          | 0.391        | <b>0.397</b> |
|                                                    |            | R <sup>2</sup> (conditional)       | <b>0.652</b> | 0.651        |
| For difficulty level 2:                            | i. vs ii.  | LR: 12.78, <i>p</i> -value:3.50e-4 |              |              |
| <i>i. log(RT) ~ 1 + (1 Subset)</i>                 |            | metric                             | linear       | logarithmic  |
| <i>ii. log(RT) ~ Age + (1 Subset)</i>              | ii. vs iii | - RMSE                             | 0.398        | <b>0.387</b> |
| <b><i>iii. log(RT) ~ log(Age) + (1 Subset)</i></b> |            | R <sup>2</sup> (marginal)          | 0.400        | <b>0.408</b> |
|                                                    |            | R <sup>2</sup> (conditional)       | <b>0.671</b> | 0.670        |
| For difficulty level 3:                            | i. vs ii.  | LR: 8.21, <i>p</i> -value:4.19e-3  |              |              |
| <i>i. log(RT) ~ 1 + (1 Subset)</i>                 |            | metric                             | linear       | logarithmic  |
| <i>ii. log(RT) ~ Age + (1 Subset)</i>              | ii. vs iii | - RMSE                             | 0.433        | <b>0.423</b> |
| <b><i>iii. log(RT) ~ log(Age) + (1 Subset)</i></b> |            | R <sup>2</sup> (marginal)          | 0.390        | <b>0.397</b> |
|                                                    |            | R <sup>2</sup> (conditional)       | <b>0.652</b> | 0.651        |

**Table S6.** (a) Parameters for the linear mixed model with working memory RT (only stimulus amount = 1) as the outcome and Age (cont) as predictors. (b) Parameters for the linear mixed model with working memory RT (only stimulus amount = 2) as the outcome and Age (cont) as predictors. (c) Parameters for the logarithmic mixed model with working memory RT (only stimulus amount = 3) as the outcome and Age (cont) as predictors.

| <b>(a) working memory RT (log) – Stimulus amount = 1</b> |             |            |        |        |        |        |
|----------------------------------------------------------|-------------|------------|--------|--------|--------|--------|
| Predictors                                               | Coefficient | Std. Error | z      | P> z   | [0.025 | 0.975] |
| (Intercept)                                              | 3.665       | 0.355      | 10.328 | <0.001 | 4.360  | 4.273  |
| Age (log)                                                | -0.898      | 0.202      | -4.438 | <0.001 | -0.501 | -0.475 |
| Group Var                                                | 0.076       | 0.079      |        |        |        |        |
| Observations                                             | 422         |            |        |        |        |        |
| Groups                                                   | 23          |            |        |        |        |        |
| RMSE                                                     | 0.423       |            |        |        |        |        |
| Marginal R <sup>2</sup>                                  | 0.397       |            |        |        |        |        |
| Conditional R <sup>2</sup>                               | 0.651       |            |        |        |        |        |

| <b>(b) Working memory RT (log) – Stimulus amount = 2</b> |             |            |        |        |        |        |
|----------------------------------------------------------|-------------|------------|--------|--------|--------|--------|
| Predictors                                               | Coefficient | Std. Error | z      | P> z   | [0.025 | 0.975] |
| (Intercept)                                              | 3.828       | 0.360      | 10.644 | <0.001 | 3.123  | 4.532  |
| Age (log)                                                | -0.879      | 0.204      | -4.306 | <0.001 | -1.279 | -0.479 |
| Group Var                                                | 0.068       | 0.082      |        |        |        |        |
| Observations                                             | 326         |            |        |        |        |        |
| Groups                                                   | 23          |            |        |        |        |        |
| RMSE                                                     | 0.387       |            |        |        |        |        |
| Marginal R <sup>2</sup>                                  | 0.408       |            |        |        |        |        |
| Conditional R <sup>2</sup>                               | 0.670       |            |        |        |        |        |

| <b>(c) Working memory RT (log) – Stimulus amount = 3</b> |             |            |        |        |        |        |
|----------------------------------------------------------|-------------|------------|--------|--------|--------|--------|
| Predictors                                               | Coefficient | Std. Error | z      | P> z   | [0.025 | 0.975] |
| (Intercept)                                              | 3.737       | 0.387      | 9.663  | <0.001 | 2.979  | 4.495  |
| Age (log)                                                | -0.701      | 0.219      | -3.205 | 0.001  | -1.129 | -0.272 |
| Group Var                                                | 0.056       | 0.088      |        |        |        |        |
| Observations                                             | 187         |            |        |        |        |        |
| Groups                                                   | 23          |            |        |        |        |        |
| RMSE                                                     | 0.327       |            |        |        |        |        |
| Marginal R <sup>2</sup>                                  | 0.324       |            |        |        |        |        |
| Conditional R <sup>2</sup>                               | 0.651       |            |        |        |        |        |

**Table S7.** Mixed regression results for the RT outcome variable in the Corsi Block-Tapping task.

| <b>Working memory RT – Difficulty effect</b> |             |            |        |         |        |        |
|----------------------------------------------|-------------|------------|--------|---------|--------|--------|
| Predictors                                   | Coefficient | Std. Error | z      | P> z    | [0.025 | 0.975] |
| (Intercept)                                  | 2.715       | 0.159      | 17.121 | <0.0001 | 2.404  | 3.026  |
| Age                                          | -0.132      | 0.025      | -5.191 | <0.0001 | -0.182 | 0.082  |
| Stimulus amount                              | 0.123       | 0.035      | 3.535  | <0.0001 | 0.055  | 0.191  |
| Age:Stimulus Amount                          | 0.010       | 0.005      | 1.847  | 0.065   | -0.001 | 0.020  |
| Group Var                                    | 0.075       | 0.086      |        |         |        |        |
| Observations                                 | 1141        |            |        |         |        |        |
| Groups                                       | 24          |            |        |         |        |        |
| RMSE                                         | 0.370       |            |        |         |        |        |
| Marginal R <sup>2</sup>                      | 0.452       |            |        |         |        |        |
| Conditional R <sup>2</sup>                   | 0.730       |            |        |         |        |        |

### 3.2.2. ToNI task

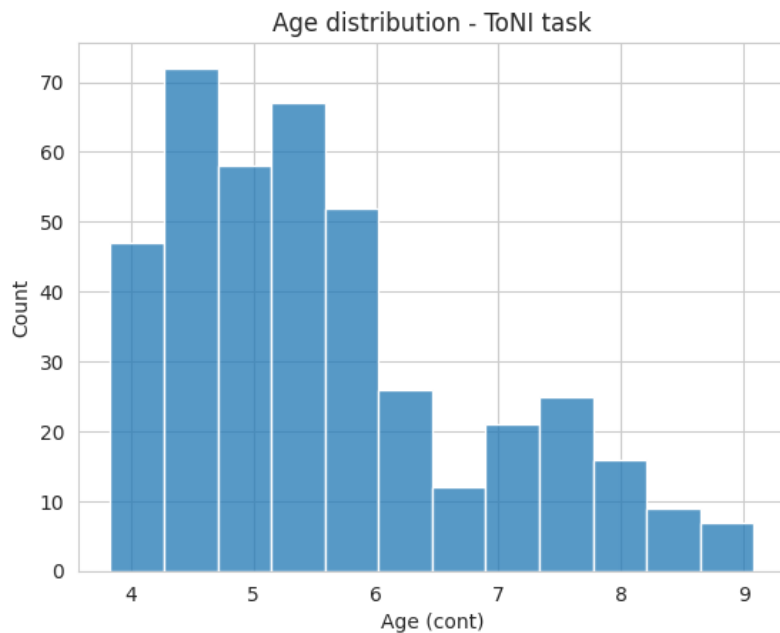


**Figure S8.** Age distribution for the participants of the ToNI task included in the analysis.

**Table S8.** Parameters for the logarithmic mixed model with relational Score as the outcome and Age (log) as predictor.

| Relational Score (log)     |             |            |       |                  |        |        |
|----------------------------|-------------|------------|-------|------------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z     | $P >  z $        | [0.025 | 0.975] |
| (Intercept)                | 1.257       | 0.0378     | 3.322 | <b>0.001</b>     | 0.515  | 1.999  |
| Age (log)                  | 1.494       | 0.219      | 6826  | <b>&lt;0.001</b> | 1.065  | 1.923  |
| Group Var                  | 0.024       | 0.023      |       |                  |        |        |
| Observations               | 412         |            |       |                  |        |        |
| Groups                     | 22          |            |       |                  |        |        |
| RMSE                       | 0.704       |            |       |                  |        |        |
| Marginal R <sup>2</sup>    | 0.188       |            |       |                  |        |        |
| Conditional R <sup>2</sup> | 0.228       |            |       |                  |        |        |

**Table S9.** Parameters for the logarithmic mixed model with log relational RT as the outcome and Age (log) and Trial Number (log) as predictors.

| Relational RT (log)        |             |            |         |                  |        |        |
|----------------------------|-------------|------------|---------|------------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z       | $P >  z $        | [0.025 | 0.975] |
| (Intercept)                | 1.475       | 0.213      | 6.908   | <b>&lt;0.001</b> | 1.056  | 1.893  |
| Age (log)                  | -0.765      | 0.117      | -6.546  | <b>&lt;0.001</b> | -0.995 | -0.536 |
| Trial Number (log)         | 0.724       | 0.036      | 199.924 | <b>&lt;0.001</b> | 0.653  | 0.795  |
| Group Var                  | 0.012       | 0.015      |         |                  |        |        |
| Observations               | 1418        |            |         |                  |        |        |
| Groups                     | 12          |            |         |                  |        |        |
| RMSE                       | 0.453       |            |         |                  |        |        |
| Marginal R <sup>2</sup>    | 0.305       |            |         |                  |        |        |
| Conditional R <sup>2</sup> | 0.346       |            |         |                  |        |        |

**Table S10.** Full model output for Score and RT (log) response variables in the ToNI-4 task. In bold the selected models and the best metric in each case.

| Score                                                                                                           |            |                                      |                                       |              |
|-----------------------------------------------------------------------------------------------------------------|------------|--------------------------------------|---------------------------------------|--------------|
| Models                                                                                                          |            | Comparison                           |                                       |              |
|                                                                                                                 |            | i. vs ii.                            | LR: 30.32 , <i>p</i> -value: 3.67 e-8 |              |
| i. $\log(\text{Score}) \sim 1 + (1 \text{Subset})$                                                              |            | metric                               | linear                                | logarithmic  |
| ii. $\log(\text{Score}) \sim \text{Age} + (1 \text{Subset})$                                                    |            | - RMSE                               | 0.708                                 | <b>0.704</b> |
| iii. $\log(\text{Score}) \sim \log(\text{Age}) + (1 \text{Subset})$                                             | ii. vs iii | R <sup>2</sup> (marginal)            | 0.182                                 | <b>0.188</b> |
|                                                                                                                 |            | R <sup>2</sup> (conditional)         | 0.223                                 | <b>0.227</b> |
| RT                                                                                                              |            |                                      |                                       |              |
| Models                                                                                                          |            | Comparison                           |                                       |              |
|                                                                                                                 |            | i. vs ii.                            | LR: 309.29, <i>p</i> -value: 3.11e-69 |              |
|                                                                                                                 |            | i vs iii.                            | LR: 7.70, <i>p</i> -value: 5.5e-3     |              |
| i. $\log(\text{RT}) \sim 1 + (1 \text{Subset})$                                                                 |            | metric                               | linear                                | logarithmic  |
| ii. $\log(\text{RT}) \sim \text{Trial Number} + (1 \text{Subset})$                                              |            | - RMSE                               | <b>0.512</b>                          | 0.514        |
| iii. $\log(\text{RT}) \sim \text{Age} + (1 \text{Subset})$                                                      | ii. vs iii | R <sup>2</sup> (marginal)            | <b>0.246</b>                          | 0.118        |
| iv. $\log(\text{RT}) \sim \text{Trial Number} + \text{Age} + (1 \text{Subset})$                                 |            | R <sup>2</sup> (conditional)         | <b>0.430</b>                          | 0.165        |
| v. $\log(\text{RT}) \sim \text{Trial Number} + \text{Age} + \text{Trial Number}:\text{Age} + (1 \text{Subset})$ | ii. vs iv. | LR: 19.64, <i>p</i> -value: 9.33 e-6 |                                       |              |
| vi. $\log(\text{RT}) \sim \text{Trial Number} + \log(\text{Age}) + (1 \text{Subset})$                           | iv. vs v.  | LR: 1.45, <i>p</i> -value: 0.23      |                                       |              |
|                                                                                                                 |            | metric                               | linear                                | logarithmic  |
|                                                                                                                 |            | - RMSE                               | 0.459                                 | <b>0.453</b> |
|                                                                                                                 | v. vs vi   | R <sup>2</sup> (marginal)            | 0.291                                 | <b>0.305</b> |
|                                                                                                                 |            | R <sup>2</sup> (conditional)         | 0.327                                 | <b>0.345</b> |

### 3.2.3. ToL task

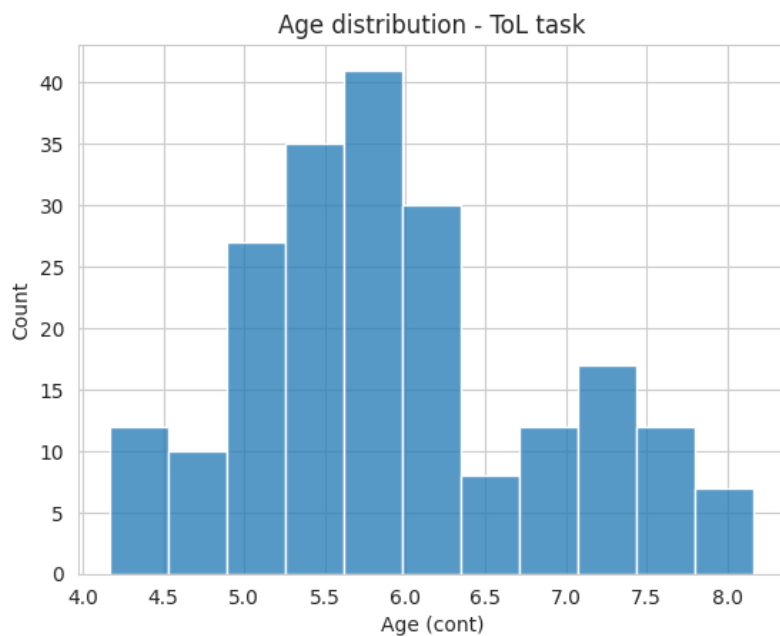


**Figure S9.** Age distribution for the participants of the ToL task included in the analysis

**Table S11.** Parameters for the logarithmic mixed model with planning Score as the outcome and Age (log) as predictors.

| Planning Score (log)       |             |            |        |              |        |        |
|----------------------------|-------------|------------|--------|--------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | P> z         | [0.025 | 0.975] |
| (Intercept)                | -2.488      | 1.544      | -1.611 | 0.107        | -5.514 | 0.539  |
| Age (log)                  | 2.887       | 0.863      | 3.346  | <b>0.001</b> | 1.196  | 4.578  |
| Group Var                  | 0.299       | 0.170      |        |              |        |        |
| Observations               | 211         |            |        |              |        |        |
| Groups                     | 11          |            |        |              |        |        |
| RMSE                       | 1.076       |            |        |              |        |        |
| Marginal R <sup>2</sup>    | 0.224       |            |        |              |        |        |
| Conditional R <sup>2</sup> | 0.415       |            |        |              |        |        |

**Table S12.** Full model output for Score variable in the ToL task.

| Score                                                               |            |                              |        |              |
|---------------------------------------------------------------------|------------|------------------------------|--------|--------------|
| i. vs ii.                                                           |            |                              |        |              |
| LR: 10.03, p-value:1.5e-3                                           |            |                              |        |              |
| i. $\log(\text{Score}) \sim 1 + (1 \text{Subset})$                  |            |                              |        |              |
| ii. $\log(\text{Score}) \sim \text{Age} + (1 \text{Subset})$        |            |                              |        |              |
| iii. $\log(\text{Score}) \sim \log(\text{Age}) + (1 \text{Subset})$ |            |                              |        |              |
|                                                                     | ii. vs iii | metric                       | linear | logarithmic  |
|                                                                     |            | - RMSE                       | 1.077  | <b>1.076</b> |
|                                                                     |            | R <sup>2</sup> (marginal)    | 0.224  | <b>0.224</b> |
|                                                                     |            | R <sup>2</sup> (conditional) | 0.390  | <b>0.415</b> |

### Section 3.3. Time-constrained tasks

#### 3.3.1. Child-ANT task

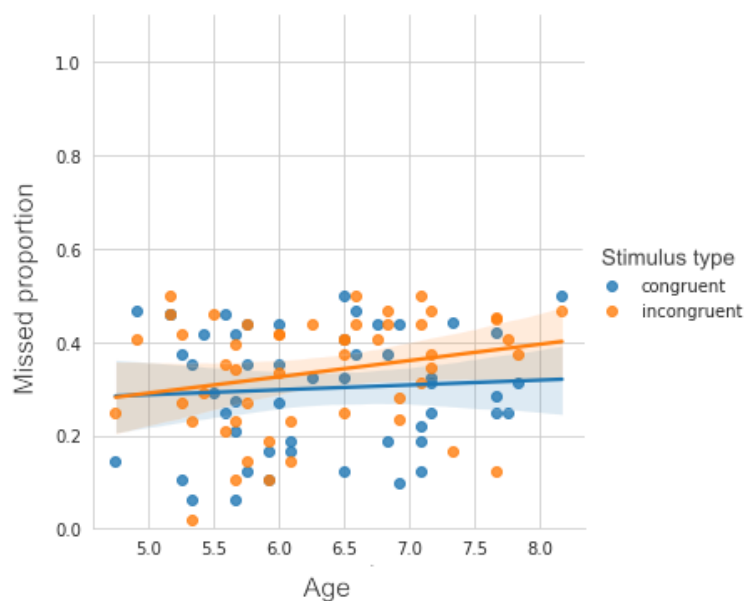


**Figure S10.** Proportion of missed trials in the original version of the Child-ANT task.

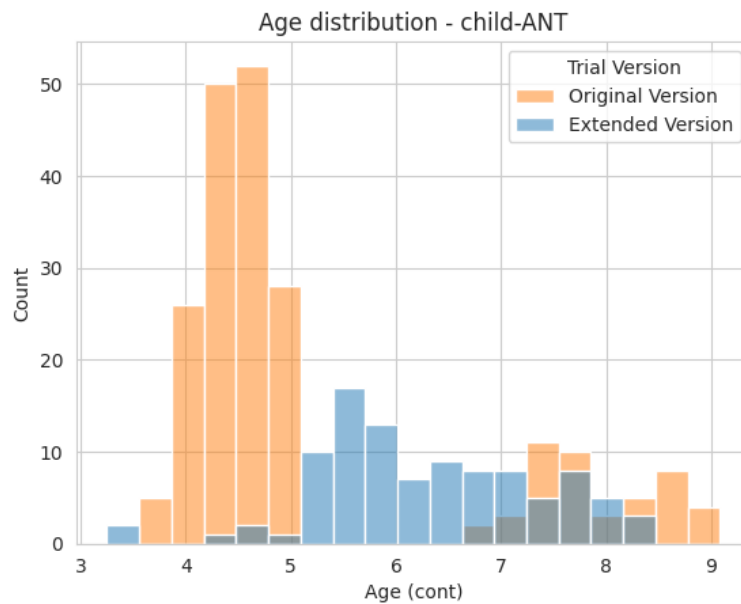


**Figure S11.** Age distribution for the original version (orange) and the extended version (blue) of the Child-ANT task

**Table S13.** Parameters for the logarithmic mixed model with ZWon as the outcome and Age (log) and Stimulus Type as predictors.

| ZWon – Original version    |             |            |        |        |        |        |
|----------------------------|-------------|------------|--------|--------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | P> z   | [0.025 | 0.975] |
| (Intercept)                | -3.177      | 0.872      | -3.641 | <0.001 | -4.886 | -1.467 |
| Age (log)                  | 1.909       | 0.456      | 4.103  | <0.001 | 0.997  | 2.821  |
| stimulus_type              | -0.683      | 0.083      | -8.186 | <0.001 | -0.847 | -0.520 |
| Group Var                  | 0.030       | 0.039      |        |        |        |        |
| Observations               | 471         |            |        |        |        |        |
| Groups                     | 7           |            |        |        |        |        |
| RMSE                       | 0.911       |            |        |        |        |        |
| Marginal R <sup>2</sup>    | 0.184       |            |        |        |        |        |
| Conditional R <sup>2</sup> | 0.213       |            |        |        |        |        |

**Table S14.** Parameters for the null mixed model with ZRT as the outcome.

| ZRT– Original version      |             |            |       |       |        |        |
|----------------------------|-------------|------------|-------|-------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z     | P> z  | [0.025 | 0.975] |
| (Intercept)                | 0.132       | 0.170      | 0.780 | 0.435 | -0.200 | 0.465  |
| Group Var                  | 0.165       | 0.102      |       |       |        |        |
| Observations               | 471         |            |       |       |        |        |
| Groups                     | 7           |            |       |       |        |        |
| RMSE                       | 1.089       |            |       |       |        |        |
| Marginal R <sup>2</sup>    | 0.116       |            |       |       |        |        |
| Conditional R <sup>2</sup> | 0.239       |            |       |       |        |        |

**Table S15.** Parameters for the logarithmic mixed model with ZWon as the outcome and Age (log) and Stimulus Type as predictors.

| ZWon – Extended version    |             |            |        |                  |        |        |
|----------------------------|-------------|------------|--------|------------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | P> z             | [0.025 | 0.975] |
| (Intercept)                | -1.719      | 0.302      | -5.687 | <b>&lt;0.001</b> | -2.312 | -1.127 |
| Age (log)                  | 1.220       | 0.290      | 6.793  | <b>&lt;0.001</b> | 0.868  | 1.572  |
| Stimulus Type              | -2.139      | 0.180      | -7.371 | <b>&lt;0.001</b> | -2.707 | -1.570 |
| Age (log):Stimulus Type    | 0.971       | 0.176      | 5.502  | <b>&lt;0.001</b> | 0.625  | 1.317  |
| Group Var                  | 0.015       | 0.012      |        |                  |        |        |
| Observations               | 1522        |            |        |                  |        |        |
| Groups                     | 9           |            |        |                  |        |        |
| RMSE                       | 0.866       |            |        |                  |        |        |
| Marginal R <sup>2</sup>    | 0.264       |            |        |                  |        |        |
| Conditional R <sup>2</sup> | 0.279       |            |        |                  |        |        |

**Table S16.** Parameters for the logarithmic mixed model with ZRT as the outcome and Age (log), Cue and Stimulus Type as predictors.

| ZRT – Extended version     |             |            |        |                   |        |        |
|----------------------------|-------------|------------|--------|-------------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | P> z              | [0.025 | 0.975] |
| (Intercept)                | -1.177      | 0.322      | -3.657 | <b>&lt;0.0001</b> | -1.808 | -0.546 |
| Stimulus                   | 0.294       | 0.049      | 6.045  | <b>&lt;0.001</b>  | 0.199  | 0.390  |
| Type[T.incongruent]        |             |            |        |                   |        |        |
| cue[T.double]              | 0.005       | 0.069      | 0.072  | 0.943             | -0.130 | 0.139  |
| cue[T.no_cue]              | 0.117       | 0.069      | 1.697  | 0.090             | -0.018 | 0.252  |
| cue[T.spatial]             | -0.014      | 0.069      | -0.201 | 0.841             | -0.149 | 0.121  |
| Age (log)                  | 0.611       | 0.187      | 3.260  | <b>0.001</b>      | 0.244  | 0.978  |
| Group Var                  | 0.024       | 0.017      |        |                   |        |        |
| Observations               | 1522        |            |        |                   |        |        |
| Groups                     | 9           |            |        |                   |        |        |
| RMSE                       | 0.957       |            |        |                   |        |        |
| Marginal R <sup>2</sup>    | 0.066       |            |        |                   |        |        |
| Conditional R <sup>2</sup> | 0.090       |            |        |                   |        |        |

**Table S17.** Full model output for Won and ZRT response variables in the original version of the child-ANT task. In bold the selected models and the best metric in each case.

| ZWon   |                                                     |             |                                      |       |        |              |
|--------|-----------------------------------------------------|-------------|--------------------------------------|-------|--------|--------------|
| Models |                                                     | Comparison  |                                      |       |        |              |
|        |                                                     | i. vs ii.   | LR: 22.57, <i>p</i> -value: 2.02 e-6 |       |        |              |
|        |                                                     | i. vs iii.  | LR: 2.80, <i>p</i> -value: 0.094     |       |        |              |
|        |                                                     | i. vs iv.   | LR: 64.55, <i>p</i> -value: 9.40     |       |        |              |
| i.     | <i>ZWon ~ 1 + (1 Subset)</i>                        |             | metric                               | null  | age    | cue          |
| ii.    | <i>ZWon ~ Age + (1 Subset)</i>                      |             | - RMSE                               | 1.005 | 0.978  | 1.002        |
| iii.   | <i>ZWon ~ Cue + (1 Subset)</i>                      |             |                                      |       |        | <b>0.940</b> |
| iv.    | <i>ZWon ~ Stimulus Type + (1 Subset)</i>            | ii. vs iii. | R <sup>2</sup>                       | 0.023 | 0.067  | 0.029        |
| v.     | <i>ZWon ~ Stimulus Type + Age + (1 Subset)</i>      | vs iv.      | (marginal)                           |       |        | <b>0.146</b> |
| vi.    | <i>ZWon ~ Stimulus Type + Cue + (1 Subset)</i>      |             | R <sup>2</sup>                       | 0.059 | 0.096  | 0.065        |
| vii.   | <i>ZWon ~ Stimulus Type + log(Age) + (1 Subset)</i> |             | (conditional)                        |       |        | <b>0.180</b> |
|        |                                                     | ii. vs v.   | LR: 21.04, <i>p</i> -value: 4.94 e-6 |       |        |              |
|        |                                                     | ii. vs vi.  | LR: 1.96, <i>p</i> -value: 0.16      |       |        |              |
|        |                                                     |             | metric                               |       | linear | logarithmic  |
|        |                                                     | vi. vs vii  | - RMSE                               |       | 0.938  | <b>0.911</b> |
|        |                                                     |             | R <sup>2</sup> (marginal)            |       | 0.149  | <b>0.184</b> |
|        |                                                     |             | R <sup>2</sup> (conditional)         |       | 0.184  | <b>0.213</b> |
| ZRT    |                                                     |             |                                      |       |        |              |
| Models |                                                     | Comparison  |                                      |       |        |              |
| i.     | <i>ZRT ~ 1 + (1 Subset)</i>                         | i. vs ii.   | LR: 0.16, <i>p</i> -value: 0.68      |       |        |              |
| ii.    | <i>ZRT ~ Age + (1 Subset)</i>                       | i vs iii.   | LR: 0.30, <i>p</i> -value: 0.58      |       |        |              |
| iii.   | <i>ZRT ~ Cue + (1 Subset)</i>                       |             |                                      |       |        |              |
| iv.    | <i>ZRT ~ Stimulus Type + (1 Subset)</i>             | i. vs iv.   | LR: 1.09, <i>p</i> -value: 0.29      |       |        |              |

**Table S18.** Full model output for Won and ZRT response variables in the extended version of the child-ANT task. In bold the selected models and the best metric in each case.

| ZWon                                                                        |                   |                                                |       |              |       |              |
|-----------------------------------------------------------------------------|-------------------|------------------------------------------------|-------|--------------|-------|--------------|
| Models                                                                      |                   | Comparison                                     |       |              |       |              |
|                                                                             | i. vs ii.         | LR: 40.22, <i>p</i> -value: 2.27 <i>e</i> -10  |       |              |       |              |
|                                                                             | i. vs iii.        | LR: 1.99, <i>p</i> -value: 0.15                |       |              |       |              |
| i. ZWon ~ 1 + (1 Subset)                                                    | i. vs iv.         | LR: 148.55, <i>p</i> -value: 3.59 <i>e</i> -34 |       |              |       |              |
| ii. ZWon ~ Age + (1 Subset)                                                 |                   | metric                                         | null  | age          | cue   | stim         |
| iii. ZWon ~ Cue + (1 Subset)                                                |                   | - RMSE                                         | 1.009 | <b>0.921</b> | 1.009 | 0.971        |
| iv. ZWon ~ Stimulus Type + (1 Subset)                                       | ii. vs iii vs iv. | R <sup>2</sup>                                 | 0.131 | 0.169        | 0.132 | <b>0.195</b> |
| v. ZWon ~ Stimulus Type + Age + (1 Subset)                                  |                   | (marginal)                                     |       |              |       |              |
| vi. ZWon ~ Stimulus Type + Cue + (1 Subset)                                 |                   | R <sup>2</sup>                                 | 0.312 | 0.180        | 0.312 | <b>0.378</b> |
| vii. ZWon ~ Stimulus Type + Age + Stimulus_type:Age + (1 Subset)            |                   | (conditional)                                  |       |              |       |              |
| viii. ZWon ~ Stimulus Type + log(Age) + Stimulus Type:log(Age) + (1 Subset) | iv. vs v.         | LR: 21.04, <i>p</i> -value: 4.94 <i>e</i> -6   |       |              |       |              |
|                                                                             | iv. vs vi.        | LR: 1.96, <i>p</i> -value: 0.16                |       |              |       |              |
|                                                                             | v. vs vii.        | LR: 30.13, <i>p</i> -value: 4.04 <i>e</i> -8   |       |              |       |              |
|                                                                             |                   | metric                                         |       | linear       |       | logarithmic  |
|                                                                             | vii. vs viii      | - RMSE                                         |       | 0.869        |       | <b>0.866</b> |
|                                                                             |                   | R <sup>2</sup> (marginal)                      |       | 0.261        |       | <b>0.264</b> |
|                                                                             |                   | R <sup>2</sup> (conditional)                   |       | 0.274        |       | <b>0.279</b> |
| ZRT                                                                         |                   |                                                |       |              |       |              |
| Models                                                                      |                   | Comparison                                     |       |              |       |              |
|                                                                             | i. vs ii.         | LR: 8.07, <i>p</i> -value: 4.4 <i>e</i> -3     |       |              |       |              |
|                                                                             | i. vs iii.        | LR: 4.76, <i>p</i> -value: 2.9 <i>e</i> -2     |       |              |       |              |
|                                                                             | i. vs iv.         | LR: 36.30, <i>p</i> -value: 1.69 <i>e</i> -9   |       |              |       |              |
| i. ZRT ~ 1 + (1 Subset)                                                     |                   | metric                                         | null  | age          | cue   | stim         |
| ii. ZRT ~ Age + (1 Subset)                                                  |                   | RMSE                                           | 0.984 | <b>0.969</b> | 0.982 | 0.972        |
| iii. ZRT ~ Cue + (1 Subset)                                                 | ii. vs iii vs iv. | R <sup>2</sup> (marginal)                      | 0.037 | 0.039        | 0.039 | <b>0.059</b> |
| iv. ZRT ~ Stimulus Type + (1 Subset)                                        |                   | R <sup>2</sup> (conditional)                   | 0.087 | 0.059        | 0.089 | <b>0.107</b> |
| v. ZRT ~ Stimulus Type + Age + (1 Subset)                                   | ii. vs v.         | LR: 8.19, <i>p</i> -value: 4.2 <i>e</i> -3     |       |              |       |              |
| vi. ZRT ~ Stimulus Type + Cue + (1 Subset)                                  | ii. vs vi.        | LR: 4.58, <i>p</i> -value: 3.2 <i>e</i> -2     |       |              |       |              |
| vii. ZRT ~ Stimulus Type + Age + Cue + (1 Subset)                           |                   | metric                                         | stim. | stim:age     |       | stim:cue     |
| viii. ZRT ~ Stimulus Type + Age + Cue + Stimulus Type:Age + (1 Subset)      | v. vs vi.         | RMSE                                           | 0.972 | <b>0.582</b> |       | 0.971        |
| ix. ZRT ~ Stimulus Type + Age + Cue + Stimulus Type:Cue + (1 Subset)        |                   | R <sup>2</sup> (marginal)                      | 0.058 | <b>0.062</b> |       | 0.061        |
| x. ZRT ~ Stimulus Type + Age + Cue + Age:Cue + (1 Subset)                   |                   | R <sup>2</sup> (conditional)                   | 0.107 | <b>0.080</b> |       | 0.110        |
| xi. ZRT ~ Stimulus Type + log(Age) + Cue + (1 Subset)                       | v. vs vii.        | LR: 4.58, <i>p</i> -value: 3.2 <i>e</i> -2     |       |              |       |              |
|                                                                             | vii. vs viii.     | LR: 0.05, <i>p</i> -value: 0.82                |       |              |       |              |
|                                                                             | vii. vs ix.       | LR: 0.58, <i>p</i> -value: 0.44                |       |              |       |              |
|                                                                             | vii. vs x.        | LR: 2.32, <i>p</i> -value: 0.13                |       |              |       |              |
|                                                                             |                   | metric                                         |       | linear       |       | logarithmic  |
|                                                                             | vii. vs xi.       | RMSE                                           |       | 0.957        |       | <b>0.957</b> |
|                                                                             |                   | R <sup>2</sup> (marginal)                      |       | 0.064        |       | <b>0.065</b> |
|                                                                             |                   | R <sup>2</sup> (conditional)                   |       | 0.083        |       | <b>0.090</b> |

### 3.3.2. The Heart-Flower Stroop task

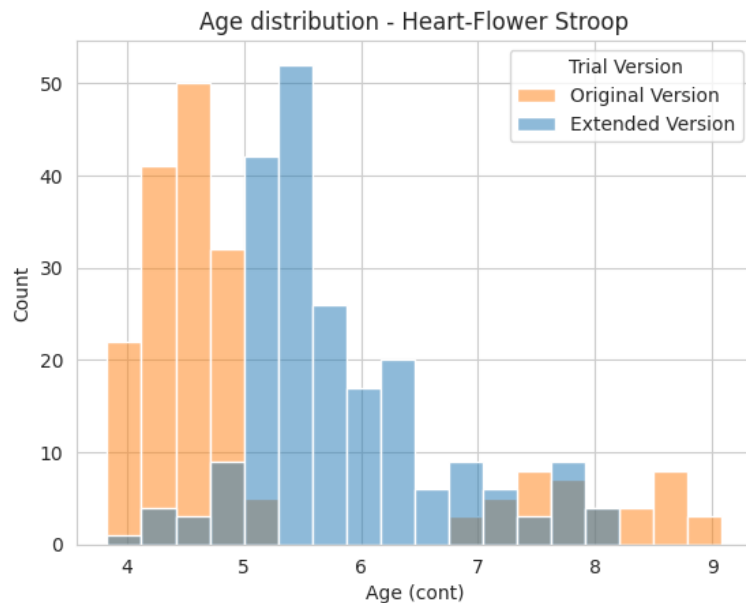


**Figure S12.** Age distribution for the original version (orange) and the extended version (blue) of the Stroop Flower-Heart task.

**Table S19.** Parameters for the linear mixed model with ZWon as the outcome and Block as predictor.

| ZWon – Original version    |             |            |        |           |        |        |
|----------------------------|-------------|------------|--------|-----------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | $P >  z $ | [0.025 | 0.975] |
| (Intercept)                | 0.832       | 0.118      | 7.061  | <0.0001   | 0.601  | 1.063  |
| block                      | -0.437      | 0.047      | -9.215 | <0.0001   | -0.530 | -0.344 |
| Group Var                  | 0.047       | 0.028      |        |           |        |        |
| Observations               | 541         |            |        |           |        |        |
| Groups                     | 14          |            |        |           |        |        |
| RMSE                       | 0.160       |            |        |           |        |        |
| Marginal R <sup>2</sup>    | 0.179       |            |        |           |        |        |
| Conditional R <sup>2</sup> | 0.206       |            |        |           |        |        |

**Table S20.** Parameters for the logarithmic mixed model with ZWon as the outcome and log Age (cont) and Block as predictors.

| ZWon – Extended version    |             |            |        |           |        |        |
|----------------------------|-------------|------------|--------|-----------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | $P >  z $ | [0.025 | 0.975] |
| (Intercept)                | -2.306      | 0.401      | -5.755 | <0.0001   | -3.091 | -1.520 |
| Age (log)                  | -0.324      | 0.044      | -7.362 | <0.001    | -0.410 | -0.237 |
| block                      | 1.834       | 0.233      | 7.874  | <0.0001   | 1.377  | 2.290  |
| Group Var                  | 0.022       | 0.024      |        |           |        |        |
| Observations               | 540         |            |        |           |        |        |
| Groups                     | 9           |            |        |           |        |        |
| RMSE                       | 0.844       |            |        |           |        |        |
| Marginal R <sup>2</sup>    | 0.303       |            |        |           |        |        |
| Conditional R <sup>2</sup> | 0.324       |            |        |           |        |        |

**Table S21.** Parameters for the logarithmic mixed model with RT (log) as the outcome and Age (cont) and Block as predictors.

| RT (log) – Original version |             |            |        |                   |        |        |
|-----------------------------|-------------|------------|--------|-------------------|--------|--------|
| Predictors                  | Coefficient | Std. Error | z      | $P >  z $         | [0.025 | 0.975] |
| (Intercept)                 | 2.511       | 0.884      | 2.839  | <b>0.005</b>      | 0.778  | 4.244  |
| block                       | 0.216       | 0.049      | 4.420  | <b>&lt;0.0001</b> | 0.120  | 0.312  |
| Age (log)                   | -1.689      | 0.502      | -3.366 | <b>0.001</b>      | -2.672 | -0.706 |
| Group Var                   | 0.058       | 0.043      |        |                   |        |        |
| Observations                | 541         |            |        |                   |        |        |
| Groups                      | 14          |            |        |                   |        |        |
| RMSE                        | 0.957       |            |        |                   |        |        |
| Marginal R <sup>2</sup>     | 0.132       |            |        |                   |        |        |
| Conditional R <sup>2</sup>  | 0.186       |            |        |                   |        |        |

**Table S22.** Parameters for the linear mixed model with ZRT as the outcome and Age (cont) and Block as predictors.

| ZRT – Extended version     |             |            |        |                   |        |        |
|----------------------------|-------------|------------|--------|-------------------|--------|--------|
| Predictors                 | Coefficient | Std. Error | z      | $P >  z $         | [0.025 | 0.975] |
| (Intercept)                | -1.371      | 0.291      | -4.711 | <b>&lt;0.0001</b> | -1.942 | -0.801 |
| block                      | 0.116       | 0.048      | 2.434  | 0.245             | 0.023  | 0.210  |
| Age                        | 0.222       | 0.048      | 4.658  | <b>&lt;0.0001</b> | 0.129  | 0.315  |
| Group Var                  | 0.040       | 0.033      |        |                   |        |        |
| Observations               | 540         |            |        |                   |        |        |
| Groups                     | 9           |            |        |                   |        |        |
| RMSE                       | 0.926       |            |        |                   |        |        |
| Marginal R <sup>2</sup>    | 0.161       |            |        |                   |        |        |
| Conditional R <sup>2</sup> | 0.200       |            |        |                   |        |        |

**Table S23.** Full model output for Won and ZRT response variables in the original version of the Stroop task. In bold the selected models and the best metric in each case.

| ZWon   |                                                 |            |                                                |              |              |
|--------|-------------------------------------------------|------------|------------------------------------------------|--------------|--------------|
| Models |                                                 |            | Comparison                                     |              |              |
| i.     | $ZW_{on} \sim 1 + (1 Subset)$                   | i. vs ii.  | $LR: 1.74, p\text{-value}: 0.187$              |              |              |
| ii.    | $ZW_{on} \sim Age + (1 Subset)$                 |            |                                                |              |              |
| iii.   | $ZW_{on} \sim Block + (1 Subset)$               | i. vs iii. | $LR: 78.69, p\text{-value}: 7.27\ e\text{-}19$ |              |              |
| ZRT    |                                                 |            |                                                |              |              |
| Models |                                                 |            | Comparison                                     |              |              |
|        |                                                 | i. vs ii.  | $LR: 9.95, p\text{-value}: 1.60\ e\text{-}2$   |              |              |
| i.     | $ZRT \sim 1 + (1 Subset)$                       | i vs iii.  | $LR: 18.77, p\text{-value}: 1.47\ e\text{-}5$  |              |              |
| ii.    | $ZRT \sim Age + (1 Subset)$                     | ii. vs iv. | $LR: 10.55, p\text{-value}: 1.16\ e\text{-}2$  |              |              |
| iii.   | $ZRT \sim Block + (1 Subset)$                   | iv. vs v.  | $LR: 0.37, p\text{-value}: 0.54$               |              |              |
| iv.    | $ZRT \sim Block + Age + (1 Subset)$             |            | metric                                         | linear       | logarithmic  |
| v.     | $ZRT \sim Block + Age + Block:Age + (1 Subset)$ |            | RMSE                                           | <b>0.955</b> | 0.957        |
| vi.    | $ZRT \sim Block + log(Age) + (1 Subset)$        | v. vs vi.  | R <sup>2</sup> (marginal)                      | 0.131        | <b>0.135</b> |
|        |                                                 |            | R <sup>2</sup> (conditional)                   | 0.168        | <b>0.186</b> |

**Table S24.** Full model output for Won and ZRT response variables in the extended version of the Stroop task. In bold the selected models and the best metric in each case.

| ZWon   |                                             |             |                               |        |
|--------|---------------------------------------------|-------------|-------------------------------|--------|
| Models |                                             | Comparison  |                               |        |
|        |                                             | i. vs ii.   | LR: 18.83, p-value: 1.43 e-5  |        |
| i.     | ZWon ~ 1 + (1 Subset)                       | i. vs iii.  | LR: 51.07, p-value: 8.90 e-13 |        |
| ii.    | ZWon ~ Age + (1 Subset)                     | iii. vs iv. | LR: 19.11, p-value: 1.233 e-5 |        |
| iii.   | ZWon ~ Block + (1 Subset)                   | iv. vs v.   | LR: 3.32, p-value: 0.068      |        |
| iv.    | ZWon ~ Block + Age + (1 Subset)             |             | metric                        | linear |
| v.     | ZWon ~ Block + Age + Block:Age + (1 Subset) |             | RMSE                          | 0.844  |
| vi.    | ZWon ~ Block + log(Age) + (1 Subset)        | iv. vs vi.  | R <sup>2</sup> (marginal)     | 0.303  |
|        |                                             |             | R <sup>2</sup> (conditional)  | 0.319  |
|        |                                             |             |                               | 0.844  |
|        |                                             |             |                               | 0.303  |
|        |                                             |             |                               | 0.324  |
| ZRT    |                                             |             |                               |        |
| Models |                                             | Comparison  |                               |        |
|        |                                             | i. vs ii.   | LR: 8.33, p-value: 3.88 e-3   |        |
| i.     | ZRT ~ 1 + (1 Subset)                        | i. vs iii.  | LR: 6.08, p-value: 1.36 e-2   |        |
| ii.    | ZRT ~ Age + (1 Subset)                      | i. vs iv.   | LR: 5.89, p-value: 1.51 e-2   |        |
| iii.   | ZRT ~ Block + (1 Subset)                    |             | metric                        | linear |
| iv.    | ZRT ~ Block + Age + (1 Subset)              | iv. vs v.   | RMSE                          | 0.936  |
| v.     | ZRT ~ Block + log(Age) + (1 Subset)         |             | R <sup>2</sup> (marginal)     | 0.156  |
|        |                                             |             | R <sup>2</sup> (conditional)  | 0.200  |
|        |                                             |             |                               | 0.937  |
|        |                                             |             |                               | 0.233  |

### 3.3.3. Composite cognitive performance score

**Table S25.** Parameters for the linear mixed model with the composite cognitive performance score as the outcome and Age (cont) as predictors.

| Cognitive performance composite score – school age (discrete) |             |            |         |                   |        |        |
|---------------------------------------------------------------|-------------|------------|---------|-------------------|--------|--------|
| Predictors                                                    | Coefficient | Std. Error | z       | P> z              | [0.025 | 0.975] |
| (Intercept)                                                   | -1.968      | 0.168      | -11.692 | <b>&lt;0.0001</b> | -2.298 | -1.638 |
| School age                                                    | 0.364       | 0.031      | 11.690  | <b>&lt;0.0001</b> | 0.303  | 0.425  |
| Group Var                                                     | 0.027       | 0.015      |         |                   |        |        |
| Observations                                                  | 1148        |            |         |                   |        |        |
| Groups                                                        | 26          |            |         |                   |        |        |
| RMSE                                                          | 0.868       |            |         |                   |        |        |
| Marginal R <sup>2</sup>                                       | 0.164       |            |         |                   |        |        |
| Conditional R <sup>2</sup>                                    | 0.193       |            |         |                   |        |        |

**Table S26.** Parameters for the linear mixed model with composite cognitive performance score as the outcome and Age (continuous) as predictors.

| Cognitive performance composite score – age (continuous) |             |            |         |         |        |        |
|----------------------------------------------------------|-------------|------------|---------|---------|--------|--------|
| Predictors                                               | Coefficient | Std. Error | z       | P> z    | [0.025 | 0.975] |
| (Intercept)                                              | -1.975      | 0.162      | -12.198 | <0.0001 | -2.293 | -1.658 |
| Age<br>(continuous)                                      | 0.334       | 0.027      | 12.449  | <0.0001 | 0.281  | 0.386  |
| Group Var                                                | 0.022       | 0.014      |         |         |        |        |
| Observations                                             | 1085        |            |         |         |        |        |
| Groups                                                   | 26          |            |         |         |        |        |
| RMSE                                                     | 0.854       |            |         |         |        |        |
| Marginal R <sup>2</sup>                                  | 0.194       |            |         |         |        |        |
| Conditional R <sup>2</sup>                               | 0.218       |            |         |         |        |        |

## References

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