1          Manybabies1 Test-Retest Supplementary Materials

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# Contents

## S1. Notes on and deviations from the preregistration

Below, we have compiled a list of notes on and deviations from the preregistered methods and analyses available at https://osf.io/v5f8t.

- All infants with usable data for both test and retest session were included in the analyses, regardless of the number of total infants a lab was able to contribute after exclusion. This decision is consistent with past decisions in ManyBabies projects to be as inclusive about data inclusion as possible (ManyBabies Consortium, 2020).
- A small number of infants whose time between sessions exceeded 31 days were still included in the analyses ($n = 3$).
- Consistent with analytic decisions in ManyBabies 1 (ManyBabies Consortium, 2020), total looking times were truncated at 18 seconds (the maximum trial time) in the small number of cases where recorded looking times were slightly greater than 18s (presumably due to small measurement error in recording infant looking times).
- In assessing differences in IDS preference between test and retest sessions, we preregistered an additional linear mixed-effects model including a by-lab random slope for session. This model yielded qualitatively equivalent results (see R markdown of the main manuscript). However, the model resulted in a singular fit, suggesting that the model specification may be overly complex and that its estimates should be interpreted with caution. We therefore focused only on the first preregistered model (including only by-lab and by-participant random intercepts) in reporting the analyses in the main manuscript.
- In assessing the reliability of IDS using a linear mixed-effects model predicting IDS preference in session 2 from IDS preference in session 1, we also assessed the robustness of the results by fitting a second preregistered model with more complex random effects structure, including a by-lab random slope for IDS preference in session 1. This model is included in the main R markdown script and yields

<sup>46</sup> qualitatively equivalent results to the model reported in the manuscript that includes

<sup>47</sup> a by-lab random intercept only.

<sup>48</sup> • We report a series of secondary planned analyses in the Supplementary Materials

<sup>49</sup> exploring potential moderating variables of time between test sessions (S2.1), the

<sup>50</sup> language background of the participants (S2.2.), and participant age (S2.3.).

<sup>51</sup> • We did not fit all models (in particular, the models investigating interactions between

<sup>52</sup> moderators) described in the secondary analyses of the preregistration, because our

<sup>53</sup> final sample size was smaller than we anticipated, which made it less feasible to

<sup>54</sup> investigate more complex relationships between moderators.

## S2. Secondary analyses investigating possible moderating variables

### S2.1. Time between test sessions

The number of days between the first and second testing session varied widely across participants (mean: 10 days; range: 1 - 49 days). We therefore tested for the possibility that the time between sessions might have an impact on test-retest reliability. We fit a linear mixed-effects model predicting IDS preference in Session 2 from IDS preference in Session 1 (mean-centered), number of days between testing sessions (mean-centered), and their interaction, including a by-lab random intercept and random slope for IDS preference in Session 1. A more complex random effects structure including additional random slopes for number of days between test sessions and its interaction with IDS preference in Session 1 did not converge. We found no evidence that the number of days between test sessions moderated the relationship between IDS preference in Session 1 and 2. Neither the main effect of time between sessions, $\beta$=-0.01, $SE$=0.03, $t(148.70)$=-0.41, $p$=.684, nor the interaction term, $\beta$=-0.01, $SE$=0.02, $t(149.10)$=-0.73, $p$=.465, showed significant effects.

### S2.2. Language background

NAE-learning infants showed greater IDS preferences than their non-NAE counterparts in MB1. We therefore also assessed whether test-retest reliability interacted with children's language background. A linear mixed-effects model predicting IDS preference in Session 2 based on IDS preference in Session 1 (mean-centered), NAE (centered), and their interaction, including Lab as a random intercept, revealed no interaction, $\beta$=0.29, $SE$=0.18, $t(151.30)$=1.59, $p$=.115 (Figure 1).

### S2.3. Participant age

To investigate the possibility that age moderated test-retest reliability, we fit a linear mixed-effects model predicting IDS preference in Session 2 from IDS preference in Session 1
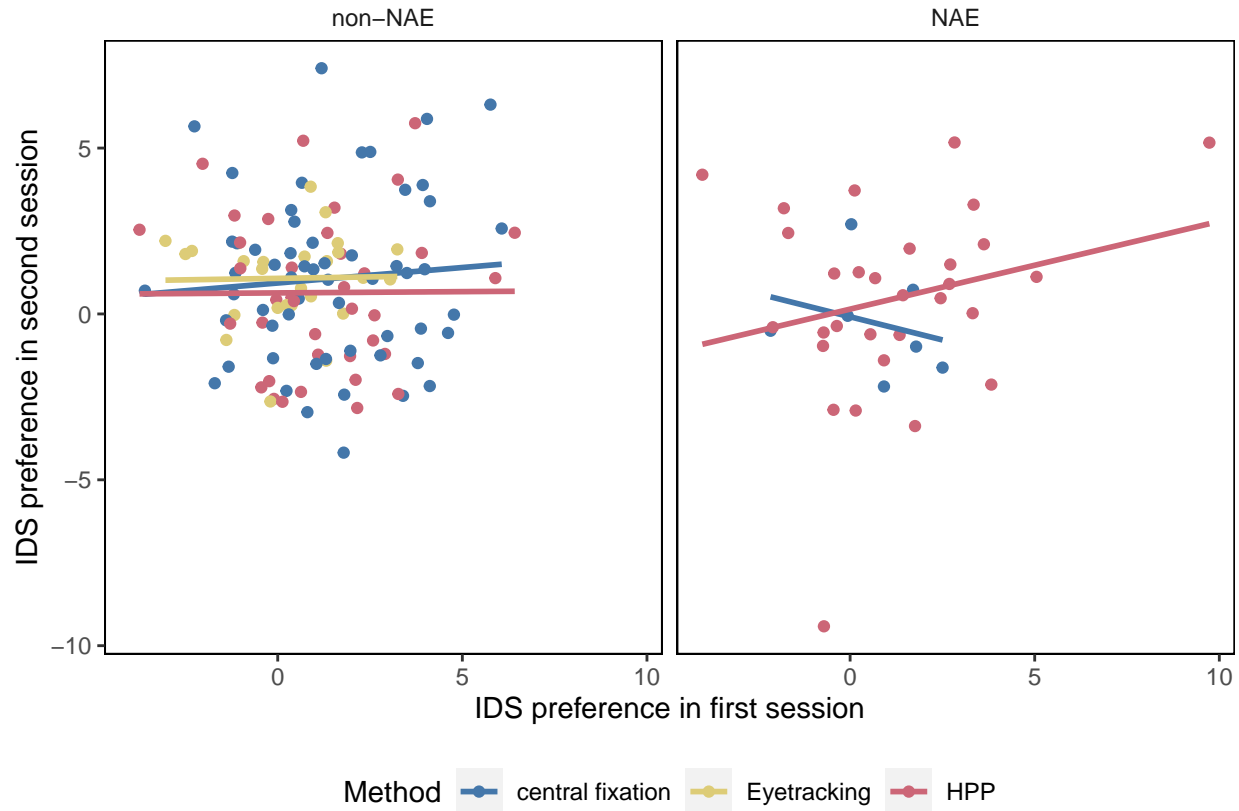
*Figure 1*. Infants' preference in Session 1 and Session 2 with individual data points and regression lines color-coded by method (CF, ET, or HPP). Results are plotted separately for North American English-learning infants (right panel) and infants learning other languages and dialects (right panel).

79 (mean-centered), participant age (mean-centered) and their interaction. The model

80 included a by-lab random intercept and a by-lab random slope for IDS preference in

81 Session 1. We found no evidence that age influenced test-retest reliability as indicated by

82 the interaction between IDS preference in Session 1 and age, $\beta$=0.00, $SE$=0.00,

83 $t(76.60)$=-0.85, $p$=.398.

**S3. Meta-analysis of test-retest reliability**

| Lab and Method | | Fisher's $z_r$ [95% CI] |
|---|---|---|
| babylab–potsdam, HPP | | −0.32 [−0.77, 0.13] |
| babyling–oslo, ET | | 0.30 [−0.44, 1.05] |
| brookes–babylab, CF | | −0.14 [−0.65, 0.37] |
| InfantCog–UBC, CF | | −0.27 [−1.25, 0.71] |
| infantll–madison, HPP | | 0.24 [−0.14, 0.62] |
| lancslab, ET | | −0.05 [−0.60, 0.49] |
| wsi–goettingen, CF | | −0.26 [−0.58, 0.07] |
| wsi–goettingen, HPP | | 0.36 [−0.19, 0.90] |
| RE Model | | −0.04 [−0.26, 0.19] |

−1.5     −0.5   0    0.5    1    1.5

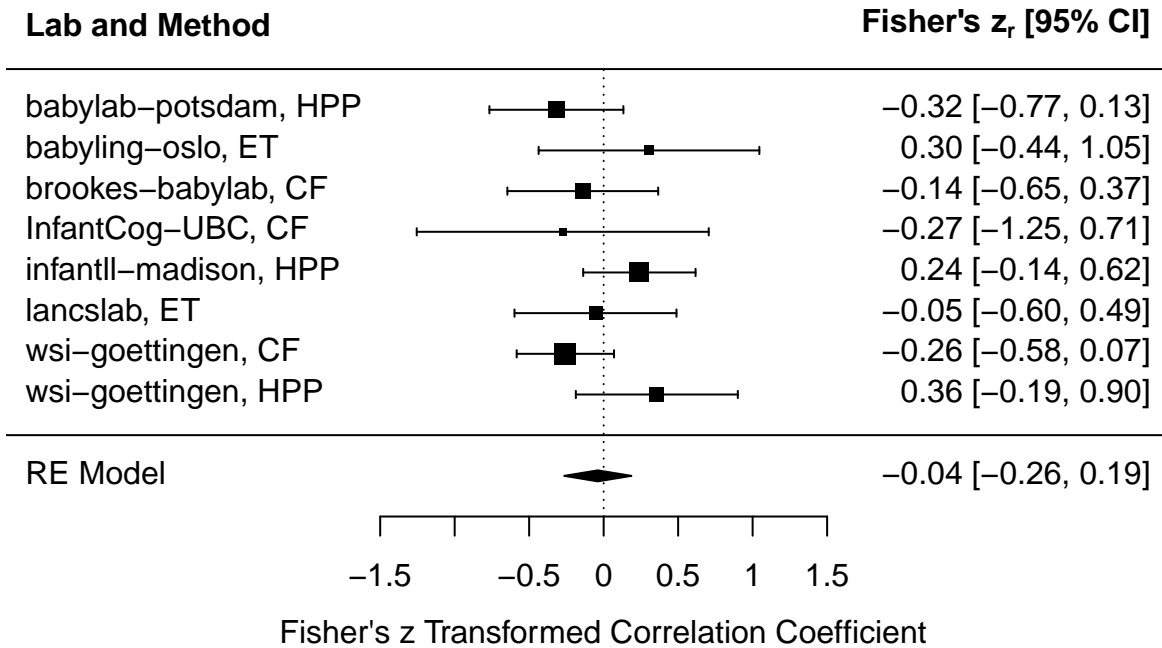Fisher's z Transformed Correlation Coefficient

*Figure 2*. Forest plot of test-retest reliability effect sizes. Each row represents Fisher's z transformed correlation coefficient and 95% CI for a given lab and method (HPP = head-turn preference procedure; ET = eye-tracking; CF = central fixation). The black diamond represents the overall estimated effect size from the mixed-effects meta-analytic model.

84    In addition to the methods for assessing test-retest reliability reported in the main

86    manuscript, we also investigated test-retest reliability across labs using a meta-analytic

87    approach. We used the metafor package (Viechtbauer, 2010) to fit a mixed-effects

88    meta-analytic model on z-transformed correlations for each combination of lab and method

89    using sample size weighting. The model included random intercepts for lab and method.

90    The overall effect size estimate was not significantly different from zero, $b$ = -0.04, 95% CI

91    = [-0.26, 0.19], $p$ = 0.73. A forest plot of the effect sizes for each lab and method is shown

92    in Figure 2.

Table 1

*Coefficient estimates from a linear mixed-effects model predicting*

*Log LT IDS preference in Session 2.*

|                                        | Estimate | SE   | t     | p    |
| -------------------------------------- | -------- | ---- | ----- | ---- |
| Intercept                              | 0.14     | 0.07 | 2.05  | 0.09 |
| Log LT IDS Preference Session 1        | -0.06    | 0.09 | -0.68 | 0.50 |

## S4. Alternative dependent variables

To check the robustness of our results, we also investigated whether we obtained
similar results with other possible dependent measures: average log-transformed looking
times and a proportion-based preference measure. For each alternative dependent variable,
we conducted the main analyses of test-retest reliability reported in the manuscript: the
overall Pearson correlation, the test-retest linear mixed-effects model, and an inspection of
applying stricter inclusion criteria for number of trials contributed.

### S4.1. Log-transformed looking times

In these analyses, we calculated IDS preference by first log-transforming looking
times for each trial, computing the average log-transformed looking time for IDS and ADS
for each participant, and calculating the difference between average IDS and ADS
log-transformed looking times. We fit a linear mixed-effects model predicting IDS
preference in Session 2 from IDS preference in Session 1, including a by-lab random
intercept. As in the analyses using average raw looking times, the results revealed no
significant relationship between IDS preference in Session 1 and 2 (Table 1). The Pearson
correlation coefficient was also not statistically significant, $r = .03$, 95% CI $[-.12, .19]$,
$t(156) = 0.43$, $p = .670$. Applying successively stricter inclusion criteria — by requiring a
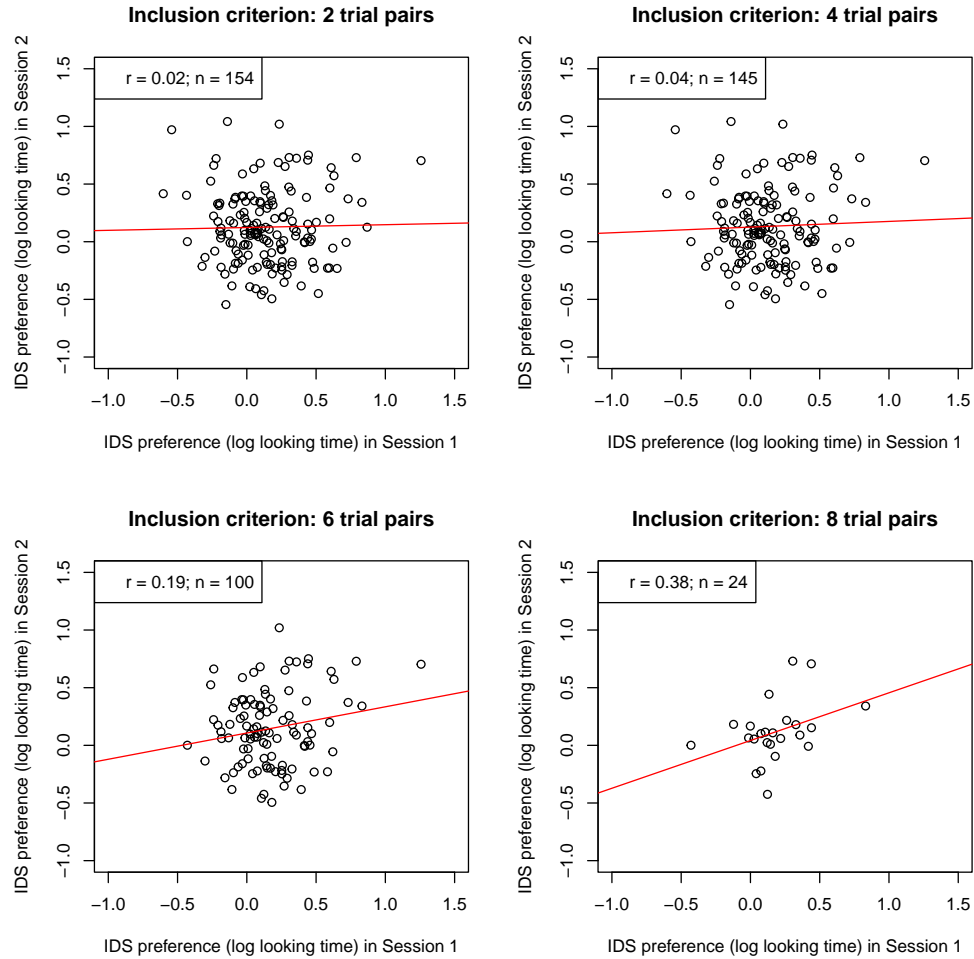
*Figure 3*. IDS preferences (based on average log-looking times) of both sessions plotted against each other for each inclusion criterion. n indicates the number of included infants, r is the Pearson correlation coefficient as the indicator for reliability.

higher number of valid trials per condition in each session — showed a similar pattern to the main manuscript, such that correlations increased somewhat with stricter inclusion criteria, but substantially reduced the sample size at the same time (Figure 3).

## S4.2. Proportion looking to IDS

Next, we calculated a proportion-based IDS preference measure by computing the average proportion (raw) looking time to IDS relative to total (raw) looking time to IDS and ADS for each subject (i.e., IDS looking time / (ADS looking time + IDS looking

117  time)). We fit a linear mixed-effects model predicting proportion-based IDS preference in

118  Session 2 from proportion-based IDS preference in Session 1, including a by-lab random

119  intercept. As in the analyses using other measures of IDS preference, the results revealed

120  no significant relationship between IDS preference in Session 1 and 2 (Table 2). The

121  Pearson correlation coefficient based on proportional IDS looking was also not statistically

122  significant, $r = .01$, 95% CI $[-.15, .16]$, $t(156) = 0.09$, $p = .927$. Stricter inclusion criteria

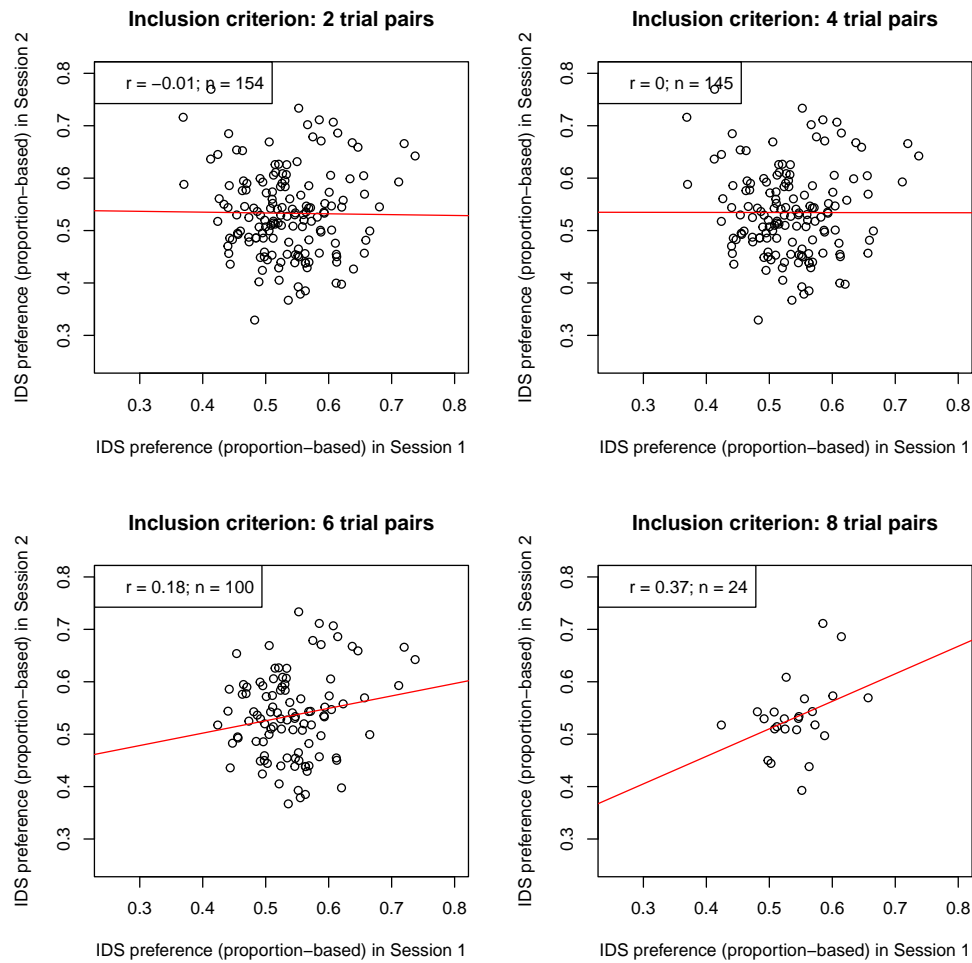123  increased the correlation somewhat, as in previous analyses (Figure 4).



*Figure 4*. IDS preferences (based on proportion IDS looking) of both sessions plotted against each other for each inclusion criterion. n indicates the number of included infants, r is the Pearson correlation coefficient as the indicator for reliability.

Table 2

*Coefficient estimates from a linear mixed-effects model predicting IDS preference
(based on proportion IDS looking) in Session 2.*

|                                                      | Estimate | SE   | t     | p    |
| ---------------------------------------------------- | -------- | ---- | ----- | ---- |
| Intercept                                            | 0.59     | 0.05 | 10.70 | 0.00 |
| IDS Preference (proportion measure) Session 1        | -0.10    | 0.10 | -1.01 | 0.31 |

## S5. Sensitivity of test-retest reliability to trial number inclusion criteria

To conduct a more fine-grained analysis of how stricter trial inclusion criteria affect test-retest reliability, we computed correlations while gradually increasing the number of total valid trials required for inclusion. For this analysis, we required a minimum of one IDS and one ADS trial and gradually increased the number of total valid trials required in both sessions (irrespective of IDS and ADS condition) from 2 to 16 (the maximum number of total trials). Figure 5 depicts the Pearson correlation coefficients for increasingly stricter requirements for the overall trial numbers of a given participant in both sessions. Correlations only increase and reach conventional levels of significance once the number of total required trials for both sessions is greater than 12.
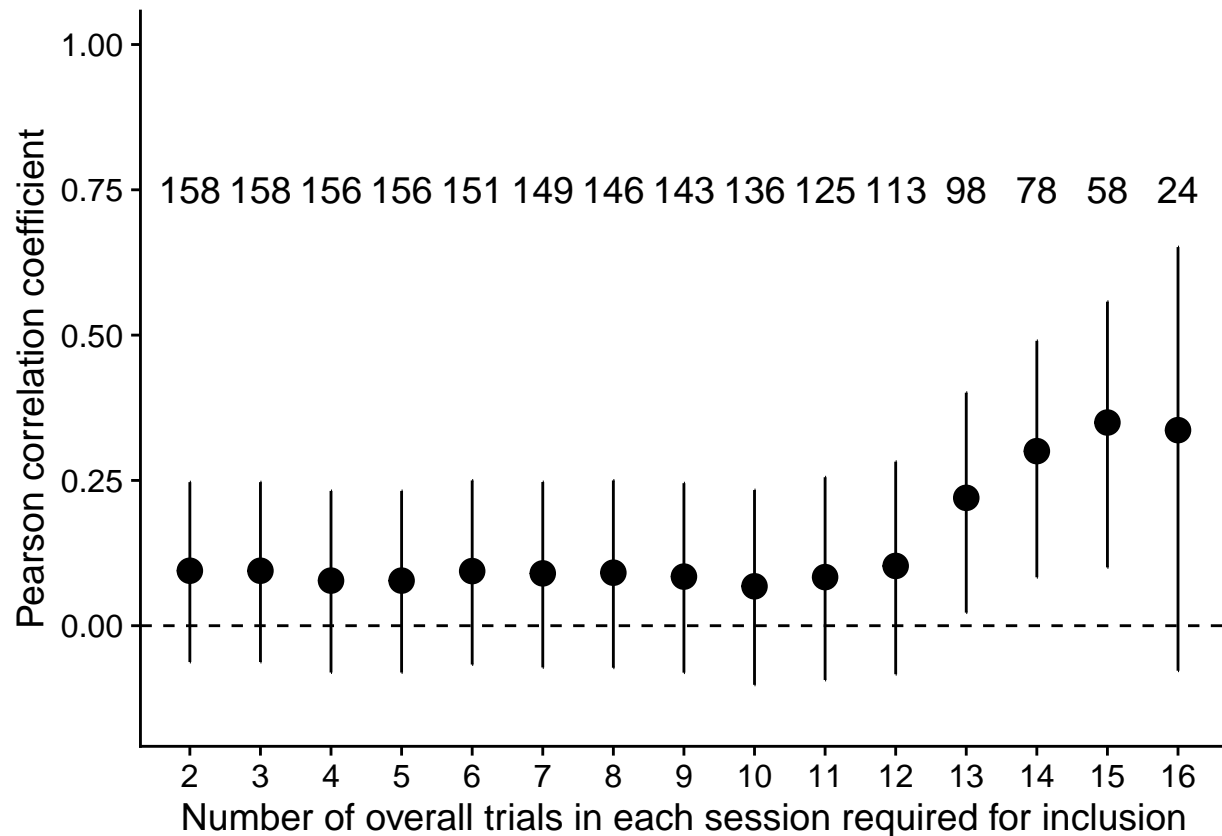
*Figure 5*. Pearson correlation coefficient with increasingly strict trial-level inclusion criteria. The x-axis depicts the required number of overall valid trials in both session 1 and session 2. Dots represent corresponding correlation coefficients, with 95 percent CIs. The sample size is shown above each dot.

## S6. Patterns of preference across sessions

We also conducted analyses to explore whether there were any patterns of preference reversal across test sessions. While there was no strong correlation in the magnitude of IDS preference between test session 1 and test session 2, here we asked whether infants consistently expressed the same preference across test sessions. Overall, 58.20% of the infants had a consistent preference from test to retest session. Of the 158 total infants, 44.90% of infants showed a consistent IDS preference and 13.30% showed a consistent ADS preference. 23.40% of infants switched from an IDS preference at test session 1 to an ADS

142 preference at test session 2 and 18.40% switched from an ADS preference to an IDS

143 preference.

144       Next, we explored whether we could detect any systematic clustering of infants with

145 distinct patterns of preference across the test and retest session. We took a bottom-up

146 approach and conducted a $k$-means clustering of the test-retest difference data (here using

147 log-transformed looking time data). We found little evidence of distinct clusters emerging

148 from these groupings: the clusterings ranging from $k=2$ (2 clusters) to $k=4$ (4 clusters)

149 appear to mainly track whether participants are approximately above or below the mean

150 looking time difference for test session 1 and test session 2 (Figure 6A). The diagnostic

151 elbow plot shows little evidence of a qualitative improvement as the number of clusters is

152 increased, which suggests little evidence for a distinctive set of clusters of participants who

153 showed similar patterns of looking across the test and retest sessions (Figure 6B).
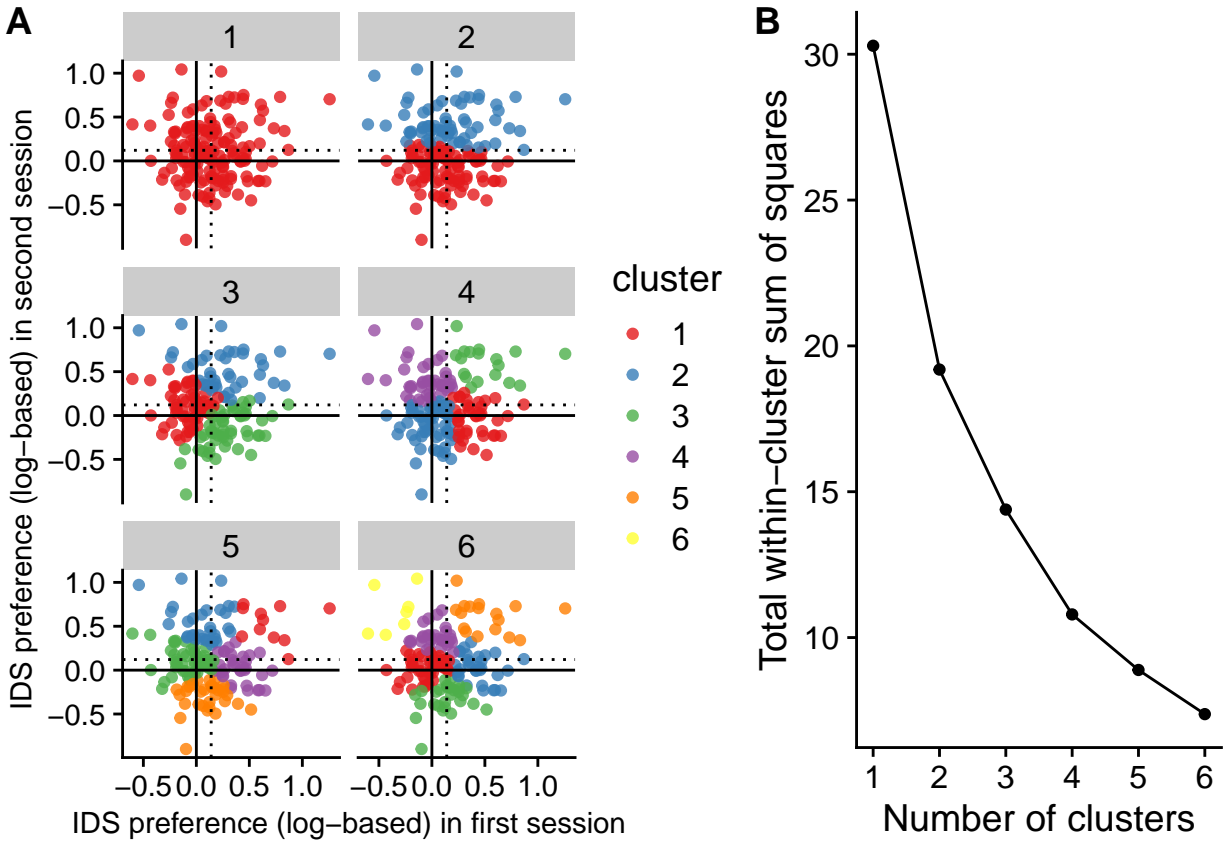
*Figure 6*. (A) Results from the k-means clustering analysis of IDS preference (based on average log looking times) in session 1 and 2 for different numbers of k and (B) the corresponding elbow plot of the total within-cluster sum of squares. In (A), points represent indvidual participants' magnitude of looking time difference at test sessions 1 (x-axis) and 2 (y-axis). The solid line indicates no preference for IDS vs. ADS, the dotted lines indicate mean IDS preference at test session 1 and 2, respectively. Colors indicate clusters from the k-means clustering for different values of k.

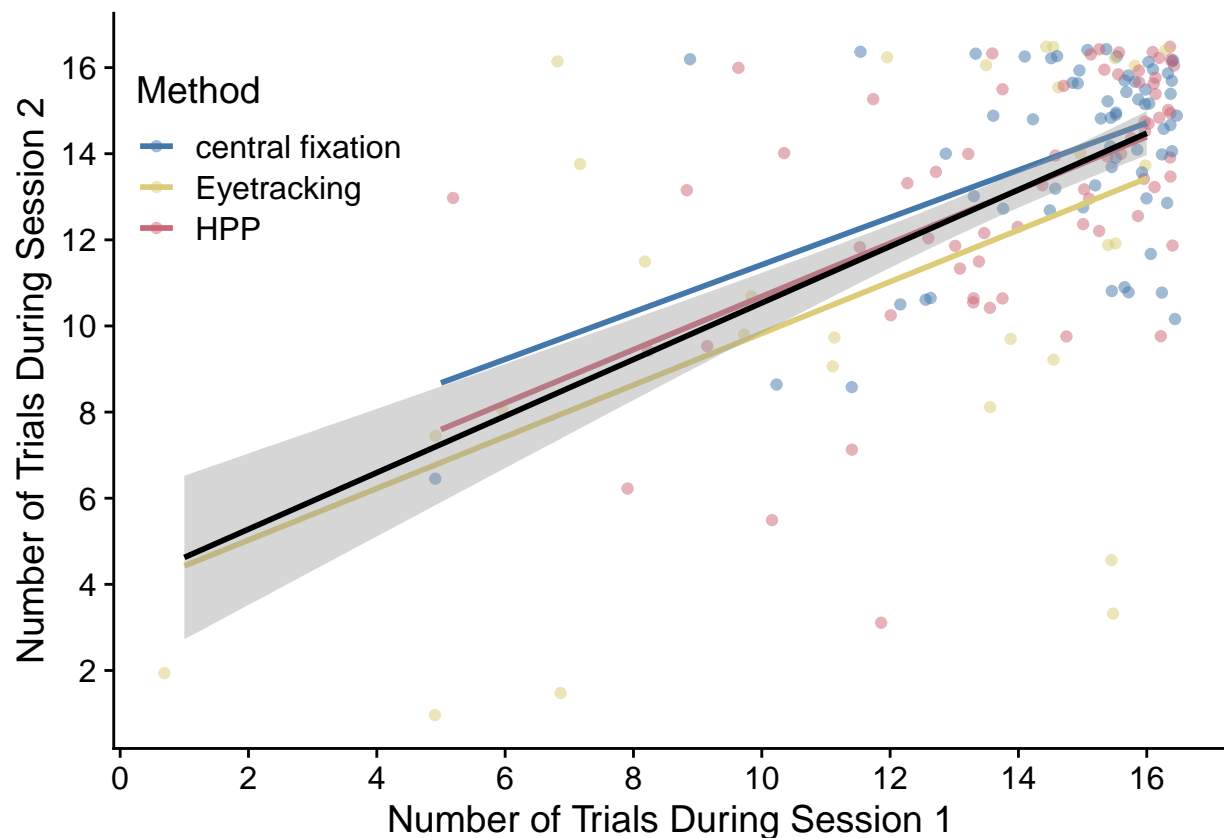154   **S7. Relation between number of contributed trials in each session**



*Figure 7.* Correlation between the number of trials contributed in Session 1 and Session 2. Each data point represents one infant. Colored lines represent linear fits for each method.

155   Are there stable individual differences in how likely an infant is to contribute a high

156   number of trials? To answer this question, we conducted an exploratory analysis

157   investigating whether there is a relationship between the number of trials an infant

158   contributed in Session 1 and Session 2. Do infants who contribute a higher number of trials

159   during their first testing session also tend to contribute more trials during their second

160   testing session? A positive correlation between trial numbers during the first and second

161   session would indicate that there is some stability in a given infants' likelihood of

162   remaining attentive throughout the experiment. On the other hand, the absence of a

163   correlation would indicate that the number of trials a given infant contributes is not

164   predictive of how many trials they might contribute during their next session.

165    We found a strong positive correlation between number of trials contributed during

166  the first and the second session $r = .58$, 95% CI [.47, .68], $t(159) = 9.05$, $p < .001$ (Figure

167  7). This result suggests that if infants contribute a higher number of trials in one session,

168  compared to other infants, they are likely to contribute a higher number of trials in their

169  next session. This finding is consistent with the hypothesis that how attentive infants are

170  throughout an experiment (and hence how many trials they contribute) is a stable

171  individual difference, at least for some infant looking time tasks. Researchers should

172  therefore be mindful of the fact that decisions about including or excluding infants based on

173  trials contributed may selectively sample a specific sub-set of the infant population they are

174  studying (Byers-Heinlein, Bergmann, & Savalei, 2021; DeBolt, Rhemtulla, & Oakes, 2020).

175        **S8. Correlations in average looking times between sessions**

176        To what extent are participants looking times between the two sessions related? To

177   test this question, we first investigated whether participants' overall looking times —

178   irrespective of condition — were correlated between the first and second session. There was

179   a robust correlation between average looking time in Session 1 and Session 2: infants with

180   longer looking times during their first session also tended to look longer during their second

181   session, $r = .45$, 95% CI $[.31, .57]$, $t(156) = 6.28$, $p < .001$. This relationship held even after

182   controlling for number of trials in the first and second session, suggesting that the relation

183   between average looking in Session 1 and 2 could not be entirely explained by the

184   correlation in the number of trials contributed between the two sessions (S7), $b = 0.42$, 95%

185   CI $[0.27, 0.58]$, $t(154) = 5.52$, $p < .001$ (Figure 8A).

186        Next, we explored the extent to which average looking times for IDS and ADS stimuli

187   were related. First, we found similar correlations in average looking time to IDS stimuli in

188   Session 1 and 2, $r = .38$, 95% CI $[.24, .51]$, $t(156) = 5.19$, $p < .001$, and ADS stimuli in

189   Session 1 and 2, $r = .40$, 95% CI $[.26, .53]$, $t(156) = 5.49$, $p < .001$ (Figure 8B). To test

190   whether these correlations were specific to looking times for IDS or ADS stimuli alone, we

191   fit linear regression models predicting average looking to IDS (or ADS) stimuli in Session 2

192   from average looking to IDS and ADS stimuli in Session 1. We found that average looking

193   to IDS stimuli in Session 2 could be predicted from average looking to IDS stimuli in

194   Session 1, even after controlling for average looking to ADS stimuli in Session 1, $b = 0.21$,

195   95% CI $[0.01, 0.41]$, $t(155) = 2.11$, $p = .037$. Conversely, average looking to ADS stimuli in

196   Session 2 could be predicted from average looking to ADS stimuli in Session 1, even after

197   controlling for average looking to IDS stimuli in Session 1, $b = 0.36$, 95% CI $[0.14, 0.58]$,

198   $t(155) = 3.20$, $p = .002$. These results suggest that the condition-specific correlations in

199   average looking time cannot be fully explained by the fact that infants' overall looking

200   times between sessions are correlated.

201      Finally, we inspected item-level correlations between the two test sessions.

202 Specifically, we investigated the relation between items composed of the same recording

203 clips in Session 1 and Session 2 (but with a reversed order of clips between the two

204 sessions). We fit a linear mixed-effects model predicting item-level looking time in Session

205 2 from item-level looking time in Session 1, including random intercepts for participant,

206 item, and lab, as well as a random slope for item-level looking time in Session 1 for

207 participant and lab. Item-level looking in Session 2 was related to item-level looking in

208 Session 1, $\hat{\beta} = 0.17$, 95% CI $[0.07, 0.27]$, $t(5.52) = 3.38$, $p = .017$ (Figure 8C). Similar

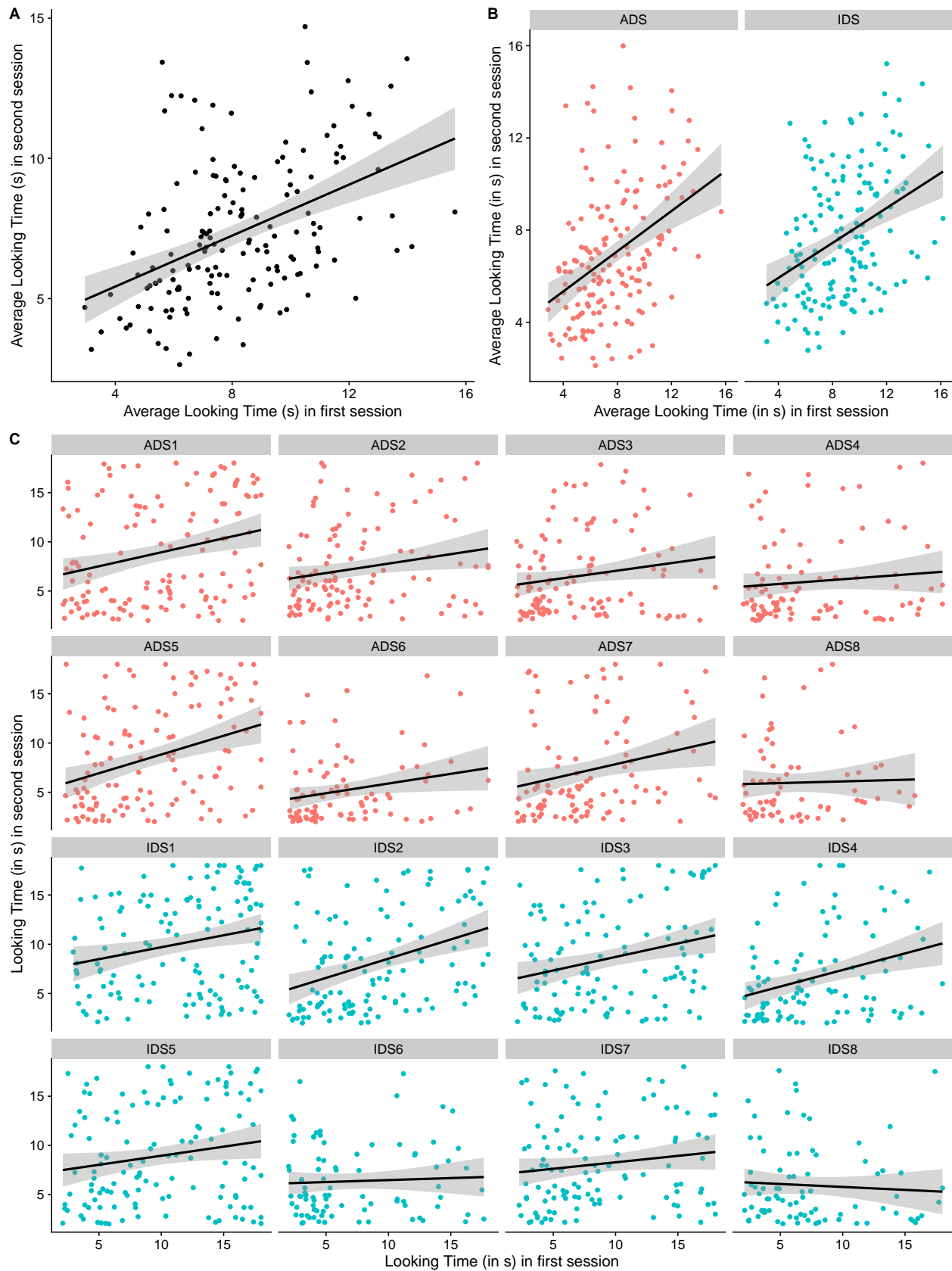209 results hold if looking times are log-transformed

*Figure 8*. Correlations in average looking time (in s) between Session 1 and 2 (A) overall, (B) by condition, and (C) by item.

Table 3

*Linear mixed-effects model results predicting IDS*

*preference in Session 2 from IDS preference in*

*Session 1 at the stimulus level.*

| Term | $\hat{\beta}$ | 95% CI | $t$ | $df$ | $p$ |
|------|------|--------|-----|------|-----|
| Intercept | 1.02 | [0.14, 1.90] | 2.27 | 6.55 | .060 |
| Diff 1 | 0.07 | [-0.01, 0.14] | 1.79 | 718.46 | .074 |

## S9. By-item-pair preference scores across sessions

Finally, we inspected on a more fine-grained item level whether IDS preference in Session 1 was related to IDS preference in Session 2. To do so, we exploited the fact the specific IDS and ADS stimuli were paired together in test orders in both sessions, such that one IDS stimulus (e.g., IDS1) always occurred adjacently to a specific ADS stimulus (e.g., ADS1). We therefore computed stimulus-specific IDS preference scores by calculating the difference in raw looking time for each of the eight IDS-ADS stimulus pairs for each participant (whenever both trials in a given pair were available). We then fit a linear mixed-effects model predicting stimulus-specific IDS preference in Session 2 from stimulus-specific IDS preference in Session 1, including by-participant and by-lab random intercepts (models with more complex random effects structure, including by-item random effects, failed to converge). There was a marginal, but non-significant relation in stimulus-specific IDS preference between the two test sessions (Table 3).

## References

Byers-Heinlein, K., Bergmann, C., & Savalei, V. (2021). Six solutions for more reliable infant research. *Infant and Child Development*, e2296.

DeBolt, M. C., Rhemtulla, M., & Oakes, L. M. (2020). Robust data and power in infant research: A case study of the effect of number of infants and number of trials in visual preference procedures. *Infancy*, *25*(4), 393–419.

ManyBabies Consortium. (2020). Quantifying sources of variability in infancy research using the infant-directed-speech preference. *Advances in Methods and Practices in Psychological Science*, *3*(1), 24–52.

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, *36*(3), 1–48. Retrieved from https://doi.org/10.18637/jss.v036.i03