Mispronunciation MetaAnalysis for CogSci

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Contents


```
## Loading tidyverse: ggplot2
## Loading tidyverse: tibble
## Loading tidyverse: tidyr
## Loading tidyverse: readr
## Loading tidyverse: purrr
## Loading tidyverse: dplyr
```

```
## Conflicts with tidy packages ---------------------------------------------
```

```
## filter(): dplyr, stats
## lag():    dplyr, stats
```

```
## Loading required package: Matrix
```

```
##
## Attaching package: 'Matrix'
```

```
## The following object is masked from 'package:tidyr':
##
##     expand
```

```
## Loading 'metafor' package (version 1.9-9). For an overview
## and introduction to the package please type: help(metafor).
```

```
## Loading 'meta' package (version 4.9-0).
## Type 'help(meta)' for a brief overview.
```

```
##
## Attaching package: 'meta'
```

```
## The following objects are masked from 'package:metafor':
##
##     baujat, forest, funnel, funnel.default, labbe, radial,
##     trimfill
```

Preparation

Read in data and tidy up dataset

Systematic Study Collection

The database contains data from 32 papers consisting of data from 2010 infants.

The next table shows what type of publications were included in our meta-analysis

publication_status	n_unique
dissertation	2
gray paper	2
paper	27
proceedings	1

Effect Size Calculation

Type of Dependent Variable

The table below summarized the type of dependent variable and subsequent comparison reported in each paper.

within_measure_descriptive	n_unique
post-naming compared to pre-naming phase	10
post-naming phase compared with chance (=50%)	9
post-pre difference score compared with chance (=0)	13

Data Used to Calculate Effect Sizes

The table below shows based on which data we calculated effect sizes. If both raw means/standard deviations as well as t-values were available, we used raw means/standard deviations to calculate effect sizes.

es_method	n_unique
group_means_one	18
group_means_two	7
t_one	4
t_two	5

Meta-Analysis

Object Identification

Correct words

Meta-analytic effect for correctly pronounced words in object identification.

```
##
## Multivariate Meta-Analysis Model (k = 104; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -111.8857   223.7713   229.7713   237.6755   230.0137
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
## tau^2      0.4483  0.6696     no
## rho        0.8886             no
##
## Test for Heterogeneity:
## Q(df = 103) = 625.6267, p-val < .0001
##
## Model Results:
##
## estimate       se     zval     pval    ci.lb    ci.ub
##   0.9078   0.1198   7.5784   <.0001   0.6730   1.1426      ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Mispronounced words

Meta-analytic effect for mispronounced words in object identification.

```
##
## Multivariate Meta-Analysis Model (k = 147; method: REML)
##
##   logLik  Deviance       AIC       BIC      AICc
## -70.1217  140.2434  146.2434  155.1942  146.4124
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
## tau^2      0.1192  0.3453     no
## rho        0.5924             no
##
## Test for Heterogeneity:
```

```
## Q(df = 146) = 462.5143, p-val < .0001
##
## Model Results:
##
## estimate       se     zval     pval    ci.lb    ci.ub
##   0.2498   0.0597   4.1835   <.0001   0.1328   0.3668      ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Mispronunciation Sensitivity

Meta-analytic effect for mispronunciation senstivity.

```
##
## Multivariate Meta-Analysis Model (k = 251; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -252.9095   505.8189   513.8189   527.8887   513.9829
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
## tau^2      0.1371  0.3703     no
## rho        0.7381             no
##
## Test for Residual Heterogeneity:
## QE(df = 249) = 1088.1411, p-val < .0001
##
## Test of Moderators (coefficient(s) 2):
## QM(df = 1) = 215.7609, p-val < .0001
##
## Model Results:
##
##            estimate      se     zval    pval   ci.lb   ci.ub
## intrcpt      0.2792  0.0652   4.2827  <.0001  0.1514  0.4069  ***
## condition    0.4953  0.0337  14.6888  <.0001  0.4293  0.5614  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Age Moderator Effects

Object identification correct words

Age moderator effects for object identification for correctly pronounced words.

```
##
## Multivariate Meta-Analysis Model (k = 104; method: REML)
##
```

```
##    logLik   Deviance        AIC        BIC       AICc
## -110.8134   221.6268   229.6268   240.1267   230.0392
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
## tau^2      0.4458  0.6677     no
## rho        0.8835             no
##
## Test for Residual Heterogeneity:
## QE(df = 102) = 619.1502, p-val < .0001
##
## Test of Moderators (coefficient(s) 2):
## QM(df = 1) = 0.6778, p-val = 0.4103
##
## Model Results:
##
##          estimate      se    zval    pval    ci.lb   ci.ub
## intrcpt    0.9202  0.1203  7.6515  <.0001   0.6845  1.1559  ***
## age.C      0.0145  0.0176  0.8233  0.4103  -0.0200  0.0490
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Object identification mispronounced words

Age moderator effects for object identification for mispronounced words.

```
##
## Multivariate Meta-Analysis Model (k = 147; method: REML)
##
##   logLik  Deviance       AIC       BIC      AICc
## -68.8541  137.7083  145.7083  157.6152  145.9940
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
## tau^2      0.1181  0.3437     no
## rho        0.5830             no
##
## Test for Residual Heterogeneity:
## QE(df = 145) = 449.1871, p-val < .0001
##
## Test of Moderators (coefficient(s) 2):
## QM(df = 1) = 1.7151, p-val = 0.1903
##
## Model Results:
##
```

```
##          estimate      se    zval    pval    ci.lb   ci.ub
## intrcpt    0.2613  0.0599  4.3583  <.0001   0.1438  0.3788  ***
## age.C      0.0149  0.0114  1.3096  0.1903  -0.0074  0.0372
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

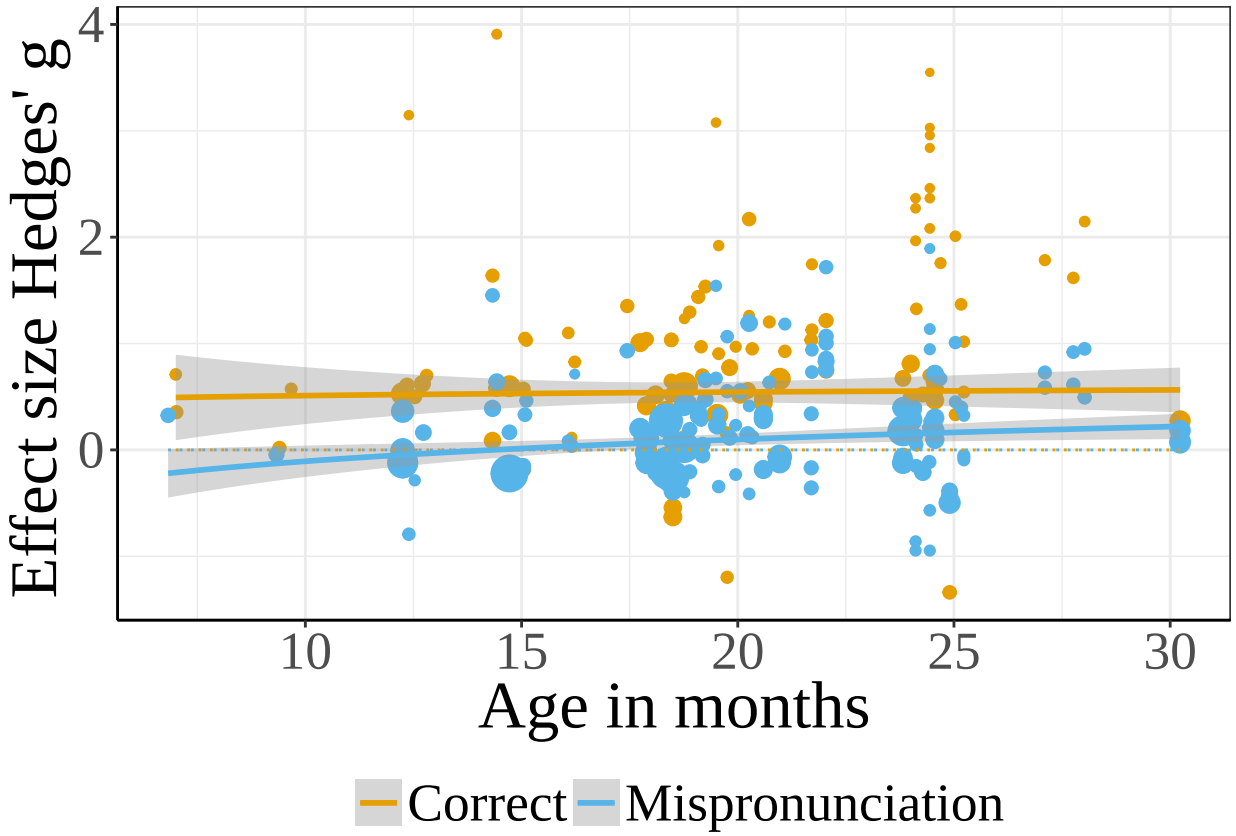
Mispronunciation sensitivity

Age moderator effects for mispronunciation sensitivity

```
##
## Multivariate Meta-Analysis Model (k = 251; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -251.2299   502.4597   514.4597   535.5160   514.8097
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
## tau^2      0.1331  0.3648     no
## rho        0.7254             no
##
## Test for Residual Heterogeneity:
## QE(df = 247) = 1068.3373, p-val < .0001
##
## Test of Moderators (coefficient(s) 2,3,4):
## QM(df = 3) = 218.6210, p-val < .0001
##
## Model Results:
##
##                  estimate      se     zval    pval    ci.lb   ci.ub
## intrcpt            0.2935  0.0648   4.5324  <.0001   0.1666  0.4204  ***
## age.C              0.0171  0.0113   1.5136  0.1301  -0.0051  0.0393
## condition          0.4984  0.0344  14.4930  <.0001   0.4310  0.5658  ***
## age.C:condition    0.0026  0.0076   0.3436  0.7312  -0.0123  0.0175
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Plotting Mispronunciation Sensitivity by Age

This is the plot used in Figure 2. Effect sizes for correct pronunciations (yellow) and mispronunciations (blue) by participant age. Point size is inverse variance. The dashed line indicates zero.



Supplementary Analyses for Discussion

This section includes supplementary analyses discussed in the Discussion section

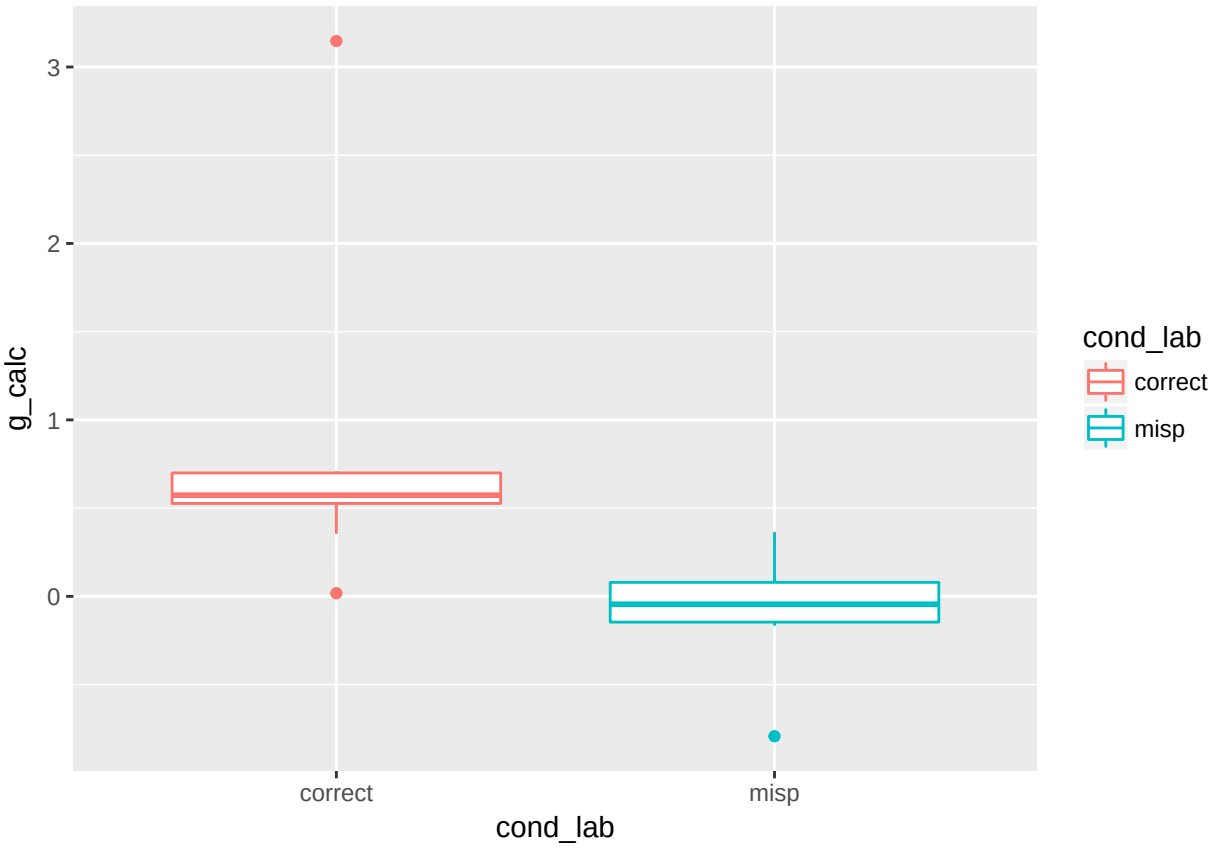
Vocabulary Data Available

This table summarizes which papers also measured vocabulary in the infants they tested.

has_vocab	count
comprehension & production	5
just comprehension	1
just production	1
none	25

Mispronunciation Sensitivity at Youngest Ages

Mispronunciation sensitivity in the papers in our dataset with the youngest ages (< 12-months-of-age; Bergelson & Swingley, 2017; Mani & Plunkett, 2007; Zesiger et al., 2012).



Known vs Novel Distractor Images

This table summarizes which papers used a known or novel distractor image.

object_pair	count
familiar_familiar	23
familiar_novel	10

Does distractor familiarity (known vs. novel) impact mispronunciation sensitivity?

Preliminary moderator test examining the influence of distractor familiarity on mispronunciation sensitivity

```
##
## Multivariate Meta-Analysis Model (k = 251; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -250.6056   501.2111   513.2111   534.2675   513.5611
##
## Variance Components:
##
## outer factor: short_cite (nlvls = 32)
## inner factor: collapse   (nlvls = 52)
##
##             estim    sqrt  fixed
```

```
## tau^2      0.1410  0.3754     no
## rho        0.7375             no
##
## Test for Residual Heterogeneity:
## QE(df = 247) = 1085.1211, p-val < .0001
##
## Test of Moderators (coefficient(s) 2,3,4):
## QM(df = 3) = 219.4592, p-val < .0001
##
## Model Results:
##
##                                                estimate      se     zval
## intrcpt                                          0.3230  0.0757   4.2641
## condition                                        0.4629  0.0384  12.0679
## as.factor(object_pair)familiar_novel            -0.1523  0.1300  -1.1711
## condition:as.factor(object_pair)familiar_novel   0.1411  0.0806   1.7510
##                                                  pval    ci.lb   ci.ub
## intrcpt                                         <.0001   0.1745  0.4714
## condition                                       <.0001   0.3877  0.5381
## as.factor(object_pair)familiar_novel            0.2416  -0.4072  0.1026
## condition:as.factor(object_pair)familiar_novel  0.0799  -0.0168  0.2991
##
## intrcpt                                         ***
## condition                                       ***
## as.factor(object_pair)familiar_novel
## condition:as.factor(object_pair)familiar_novel    .
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Plotting Influence of Distractor Familiarity