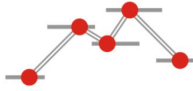


MetaLab and *metalabR*: Facilitating dynamic meta-analyses in developmental psychology

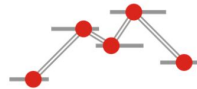
— Loretta Gasparini
& Team MetaLab —

Research Synthesis and Big Data Virtual Conference
May 18th -21st 2021

MetaLab: <http://metalab.stanford.edu/>; metalabR repo: <https://github.com/langcog/metalabr/>; Email: gasparini.lorett@gmail.com

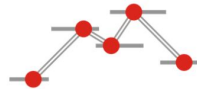


How and when do babies learn language?

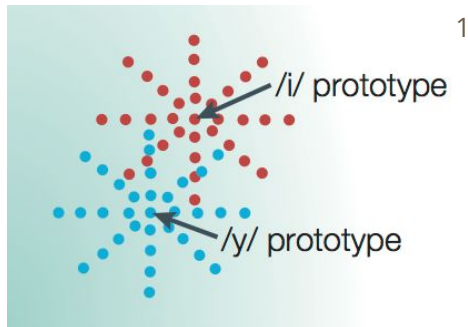


How and when do babies learn language?

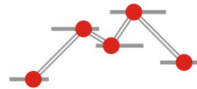




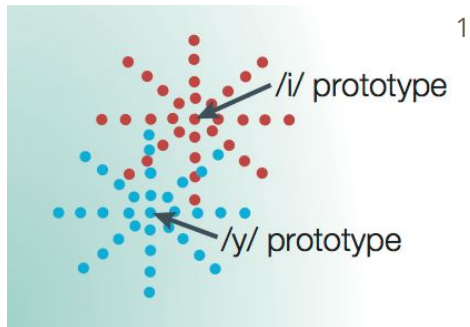
How and when do babies learn language?

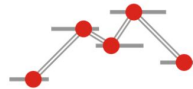


1

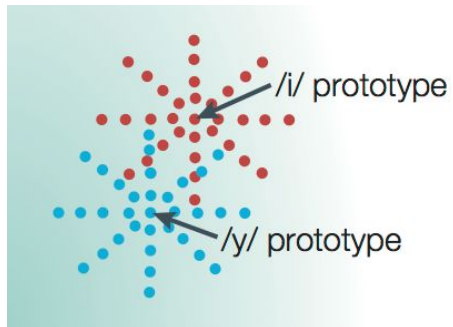


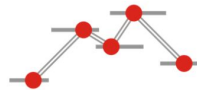
How and when do babies learn language?



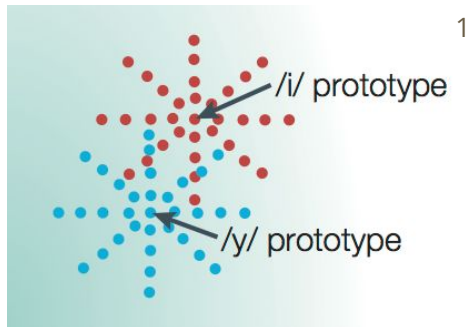


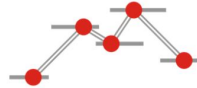
How and when do babies learn language?



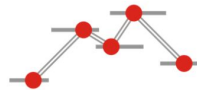


How and when do babies learn language?



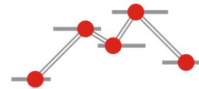


Babies can do X at age Y



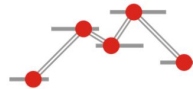
Babies can do X at age Y

- False positives (5%), false negatives (40-90%)¹
- Generalisable results? (or restricted by language, lab, stimuli, method)²



Babies can do X at age Y

- False positives (5%), false negatives (40-90%)¹
- Generalisable results? (or restricted by language, lab, stimuli, method)²
- Systematic review → Meta-analysis



MetaLab

Systematic review → Meta-analysis →
Community-augmented meta-analysis (CAMA)^{1,2}

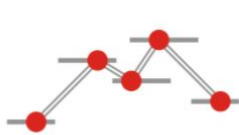
MetaLab

Explore Data ▾

Documentation

Publications

Team



MetaLab

Interactive, community-augmented meta-analysis
tools for cognitive development research

New: The [2020 Contribution Challenge Winners](#)

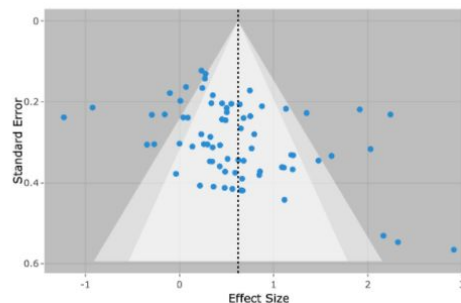
 Explore Apps

[View Documentation](#) ▸

New MetaLab User? Check out [Getting Started](#) first!

The MetaLab database contains **2,496 effect sizes** from **30 meta-analyses** across two domains of cognitive development, based on data from **687 papers** and **45,244 subjects**.

Funnel plot of bias in effect sizes



1. Cristia et al. (2020) 2. Tsuji et al. (2014)

Datasets

All Cognitive Development Early Language

Abstract rule learning

Can infants learn abstract repetition rules from different types of stimuli?

20 papers | 95 experiments | 1111 subjects



Categorization bias

In a triad-task, bias to generalize to taxonomic as opposed to thematic alternative.

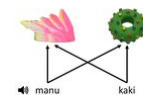
9 papers | 80 experiments | 328 subjects



Cross-situational word learning

Infants and children's abilities to learn words across multiple ambiguous situations.

16 papers | 50 experiments | 2271 subjects



Familiar word recognition

Do infants distinguish familiar words from novel/rare words in listening tasks?

16 papers | 34 experiments | 658 subjects



Function word segmentation



Applications

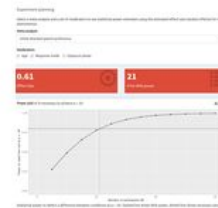
Visualization

Explore a variety of interactive charts driven by the MetaLab database by your datasets and moderators



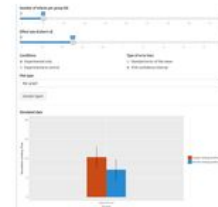
Power Analysis

Analyzes power of your experiment under a variety of conditions



Power Simulation

Simulate power of meta-analyses under a variety of conditions



Data Validation

Validate that new datasets are ready for inclusion in the MetaLab database



For more information see [Documentation](#) or [View raw dataset](#). Please cite the dataset info that you use following [our citation policy](#).

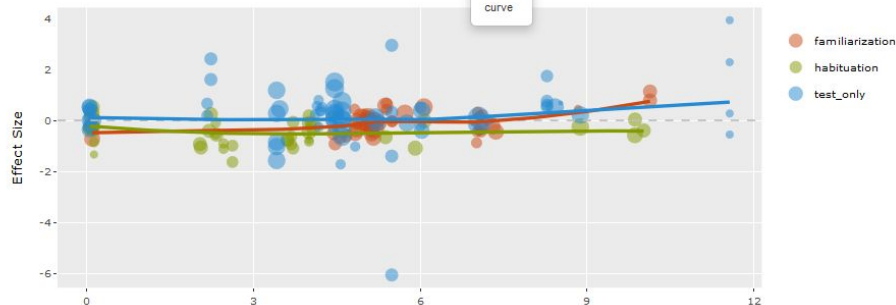
Cohen's *d* corrected for small sample sizes

Random effects model assuming studies within a paper share variance. For details, see [Statistical Approach](#).

Scatter plot of effect sizes over age

Curve type

Select
a type
of
curve

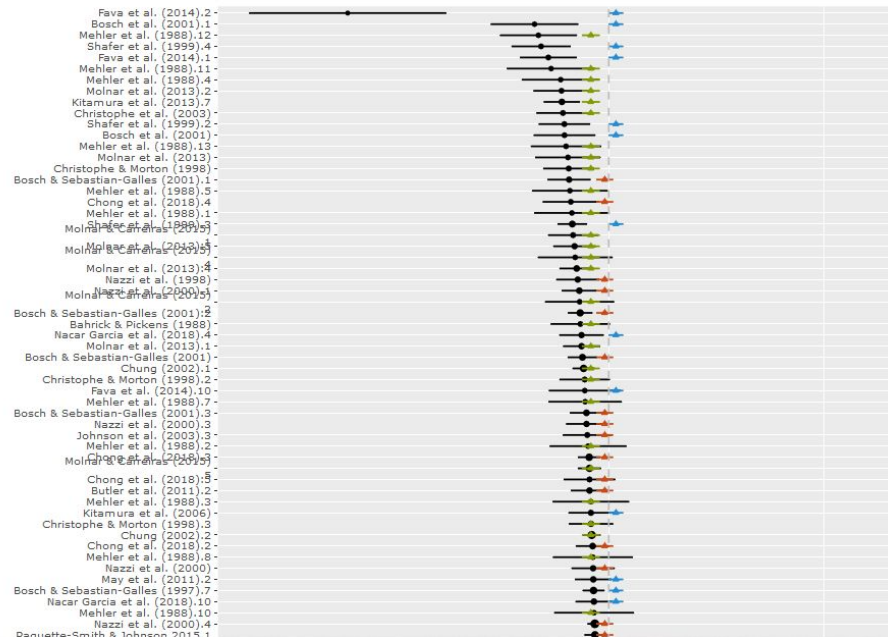


Effect Size SE

Forest plot of effect sizes and meta-analysis model estimates

Sort order

effect size



Welcome

Getting Started

Contribution Challenge

FAQ

Why Meta-Analysis?

 Using MetaLab Data**Conduct MA**

Contribute MA

Update Existing MA

Planning Studies and
Interpreting Results

Citation Policy

 Applications

Data Validator

Power Analysis

Power Simulation

Visualization

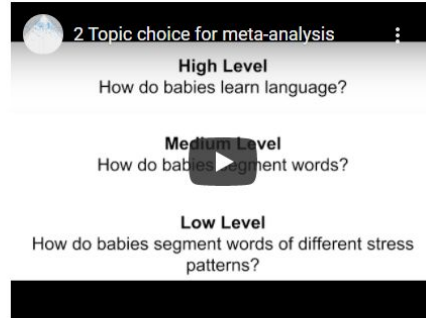
 Building the Metalab

Conduct MA

Build a MA

Choosing the right MA question

How do I define my MA question?



2 Topic choice for meta-analysis

High Level
How do babies learn language?

Medium Level
How do babies segment words?

Low Level
How do babies segment words of different stress patterns?

Choose the appropriate level of detail for your MA topic. The topic of your meta-analysis should be broader than the one of a single experiment (e.g. "How do babies segment words of different stress patterns? "), but narrower than a whole research field (e.g. "How do babies learn language? "). The goal is to be able to

[Contents](#)

Publication details

Source

Screening decisions

screening-decisions

File

Edit

View

Insert

Format

Data

Tools

Add-ons

Help

Last edit was seconds ago

<

Methodological details

Participant details

Quantitative results

language-discrimination

File Edit View Insert Format Data Tools Add-ons Help

100% \$ % .0 .00 123 Arial 10

	A	G	I	J	K	M	N	BN	BP	BR	BS	BV	BX	BY	BZ	CA	CB	CC	CD	CE	CF
1	study_ID	expt_num	same_infant	response_mode	task	method	dependent_measur	n_1	n_excluded	mean_age	age_range	gender	x_2	x_1	SD_2	SD_1	corr	r	t	F	d
2	bahrck88	1		eye-tracking	disc	CF	looking_time	16	14.5	163.6	17.2	7.500	13.400							-1.910	
3	bosch97	1	catalan_1	behavior	pref	HPP	reaction_time	10	5	129	24	1.054	1.294	0.572	0.153					-4.620	
4	bosch97	2	catalan_2	behavior	pref	HPP	reaction_time	10	3.5	126	20	1.173	1.344	0.189	0.343					-2.265	
5	bosch97	2	spanish_2	behavior	pref	HPP	reaction_time	10	3.5	128	20	1.164	1.320	0.372	0.442					-3.789	
6	bosch97	3	catalan_3	behavior	pref	HPP	reaction_time	10	4.5	125	17	1.302	1.393	0.378	0.363					-2.877	
7	bosch97	3	spanish_3	behavior	pref	HPP	reaction_time	10	4.5	127	20	1.301	1.468	0.183	0.196					-4.434	
8	bosch97	4.1	catalan_4.1	behavior	pref	HPP	reaction_time	10	2	127	20	1.597	1.454	0.498	0.508					4.620	
9	bosch97	4.2	4.2	behavior	pref	HPP	reaction_time	10	3	134	25	1.311	1.291	0.324	0.325					1.205	
10	bosch97	5	catalan_5	behavior	pref	HPP	reaction_time	10	3	135	49	1.445	1.292	0.451	0.326					2.550	
11	bosch01a	1	catalan	behavior	pref	HPP	reaction_time	10	1	147	23	1.299	1.523							-3.568	
12	bosch01a	1	spanish	behavior	pref	HPP	reaction_time	10	1	139	36	1.181	1.383							-4.903	
13	bosch01b	1	catalan_1	behavior	disc	HPP	looking_time	14	2	142	34	14.84	10.884	6.947	5.102					-4.038	
14	bosch01b	1	spanish_1	behavior	disc	HPP	looking_time	14	1	136	30	12.23	8.416	4.760	2.751					-4.203	
15	bosch01b	2	catalan_2	behavior	disc	HPP	looking_time	14	6	139	17	13.17	9.209	4.912	6.221					-6.901	
16	bosch01b	2	spanish_2	behavior	disc	HPP	looking_time	14	6	135	12	14.49	11.238	5.736	6.059					-3.003	
17	bosch10	1		eye-tracking	pref	CF	reaction_time			136.98											
18	bosch10	2		eye-tracking	pref	CF	reaction_time			136.98											
19	bosch10	3	3_mono	eye-tracking	pref	CF	reaction_time			136.98											
20	bosch10	3	3_bi	eye-tracking	pref	CF	reaction_time			136.98											
21	butler11	1		behavior	disc	HPP	looking_time	20	7	163.4628	48.0952	0.45	6.820	8.580	2.820	2.980				6.700	
22	butler11	2		behavior	disc	HPP	looking_time	20	6	153.4176	50.8348	0.35	7.930	8.190	3.250	3.460					
23	butler11	3		behavior	disc	HPP	looking_time	20	4	224.0384	80.9704	0.5	7.970	6.600	3.410	2.390				-4.480	

+ Data CodeBook Methods Data-in-publication

Explore


[Contents](#)[Welcome](#)[Getting Started](#)[Contribution Challenge](#)[FAQ](#)[Why Meta-Analysis?](#)[📊 Using MetaLab Data](#)[Conduct MA](#)[Contribute MA](#)[Update Existing MA](#)[Planning Studies and
Interpreting Results](#)[Citation Policy](#)[👤 Applications](#)[Data Validator](#)[Power Analysis](#)[Power Simulation](#)[Visualization](#)[👤 Building the Metalab](#)

Conduct MA

Build a MA

Choosing the right MA question

How do I define my MA question?

 2 Topic choice for meta-analysis

High Level
How do babies learn language?

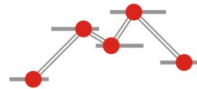
Medium Level
How do babies segment words?

Low Level
How do babies segment words of different stress patterns?

Choose the appropriate level of detail for your MA topic. The topic of your meta-analysis should be broader than the one of a single experiment (e.g. "How do babies segment words of different stress patterns? "), but narrower than a whole research field (e.g. "How do babies learn language? "). The goal is to be able to

In progress:

- Tutorials for planning a new study and adding to a CAMA
- Tutorial paper for conducting a meta-analysis

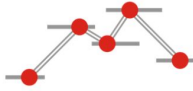


metalabR package

Reads live data

Compatible
with *metafor*¹

Visualization



metalabR package

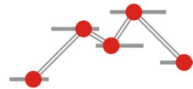
Reads live data

```
> get_metalab_data()
```

Compatible
with *metafor*¹

Visualization

1. Viechtbauer (2010)



```
> get_metalab_data()
```

Reads

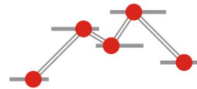
Synthesizes

Validates

Cleans

Computes
effect sizes

Returns tidy
dataframe



metalabR package

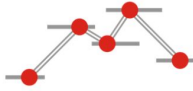
Reads live data

Compatible
with *metafor*¹

`> rma.mv()`

Visualization

1. Viechtbauer (2010)



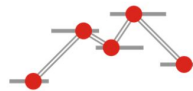
metalabR package

Reads live data

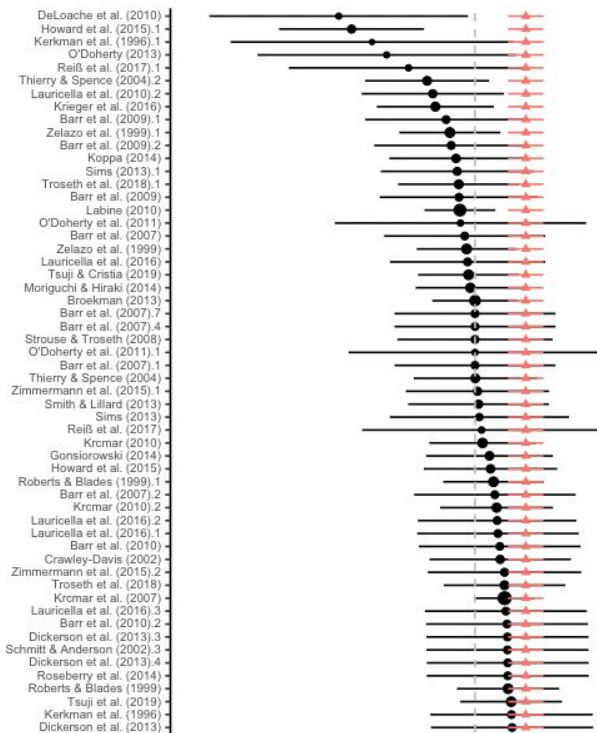
Compatible
with *metafor*¹

Visualization

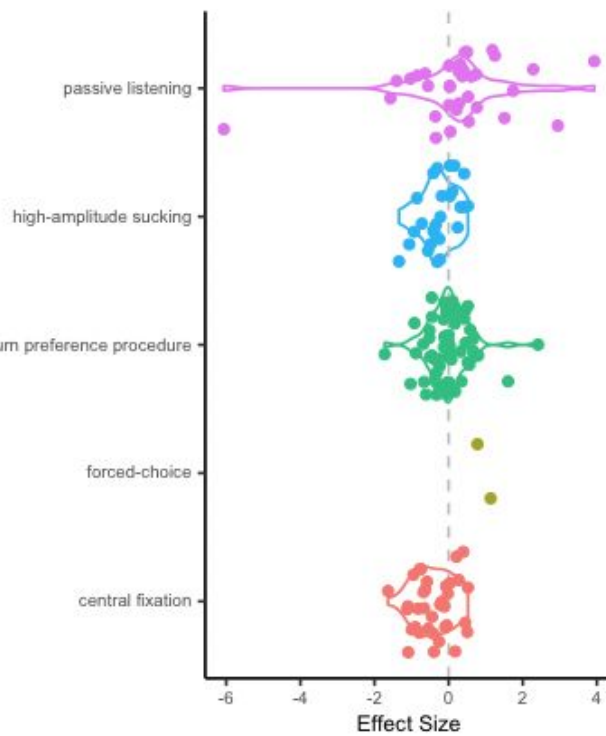
1. Viechtbauer (2010)



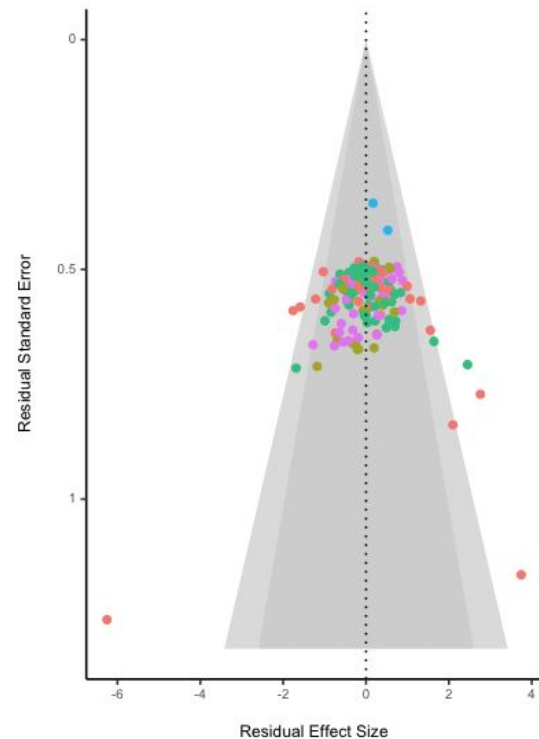
> forest_plot(...)



> violin_plot(...)



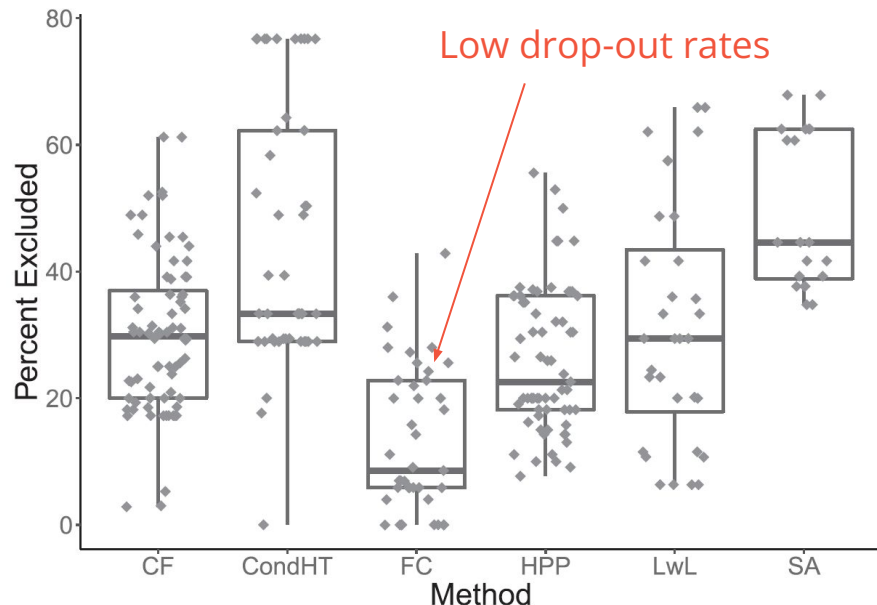
> funnel_plot(...)



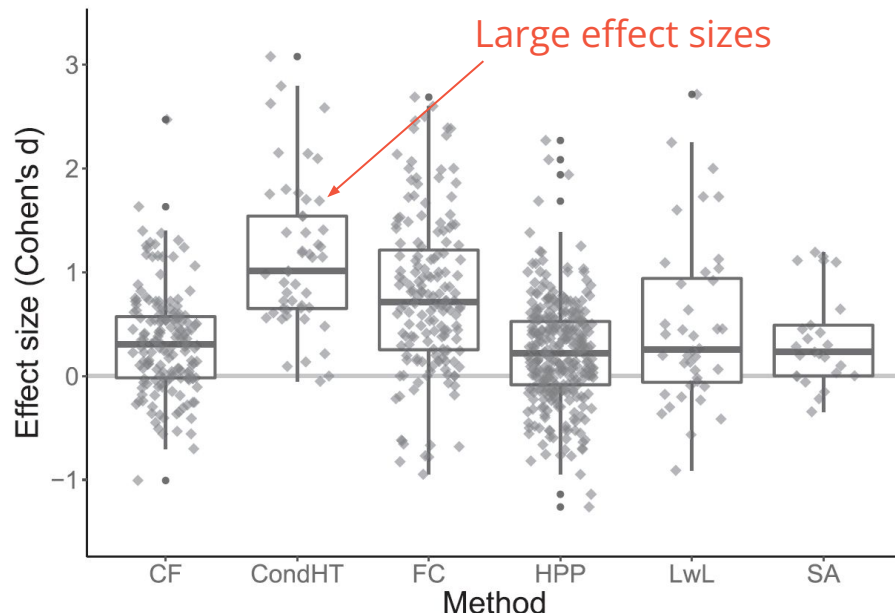
Meta-meta-analyses

Meta-meta-analyses: Method choice

Exclusion rate in percent by different methods

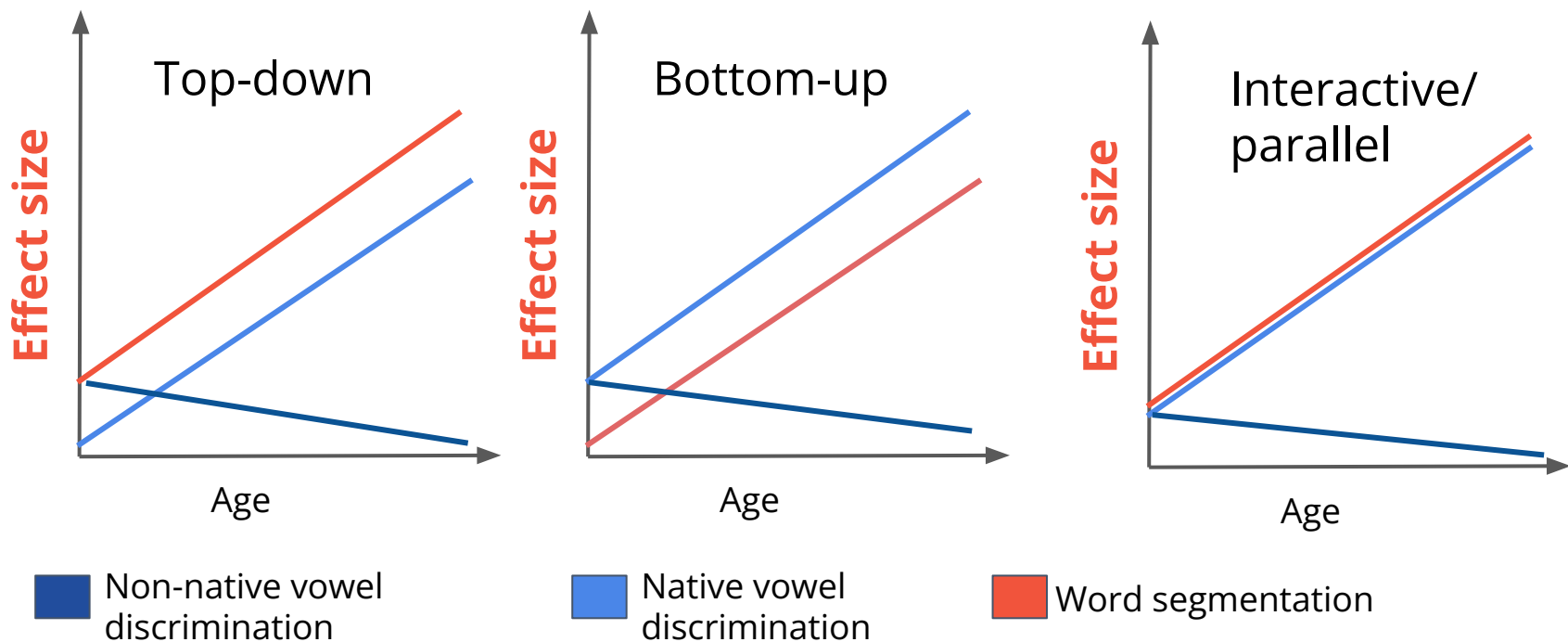


Effect size by different methods

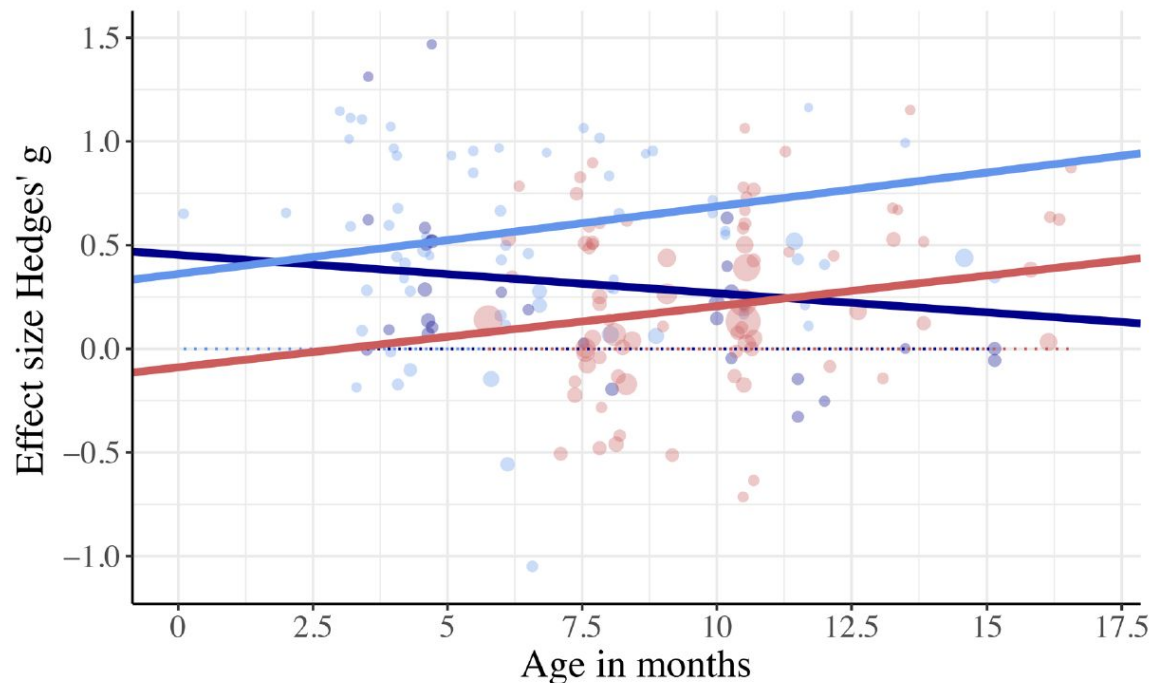


CF = central fixation; CondHT = conditioned headturn; FC = forced choice; HPP = headturn preference procedure; LwL = looking while listening; SA = stimulus alternation. Each point indicates a single study.

Meta-meta-analyses: Phonological acquisition



Meta-meta-analyses: Phonological acquisition



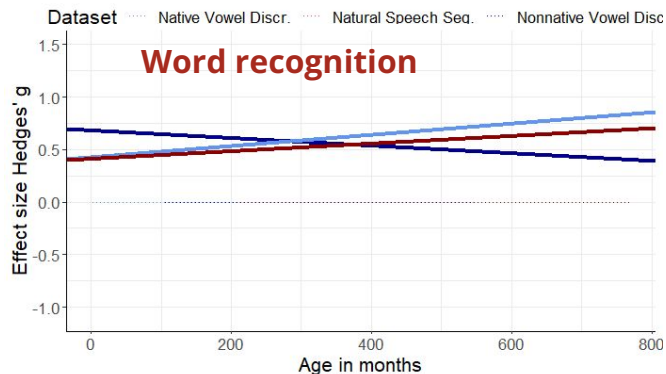
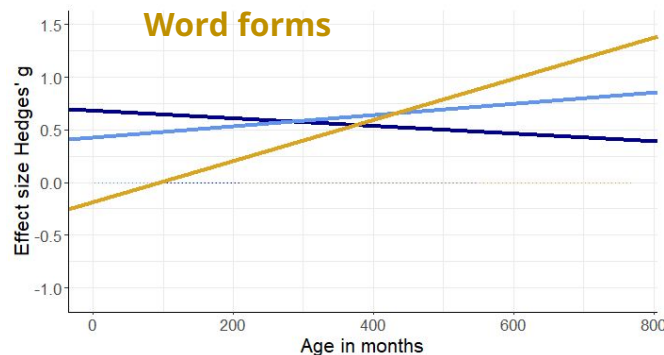
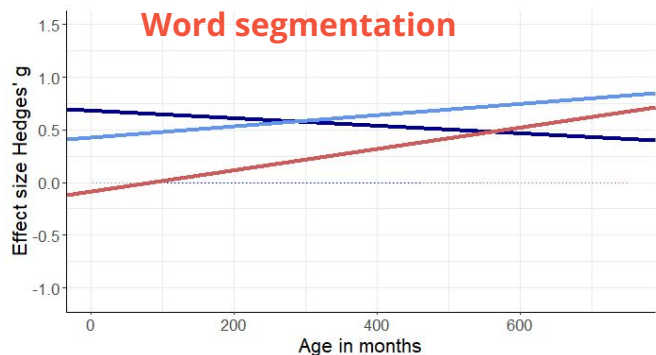
Dataset —•—•— Vowels-Native —•—•— Vowels-Nonnative —•—•— WordSeg

Initial analysis:

Segmentation skills emerge after native vowel attunement →

Not supporting top-down theories

Meta-meta-analyses: Phonological acquisition



Dataset Native Vowel Discr. Nonnative Vowel Discr. Word Recognition

Subsequent analyses:

Word recognition from 6 months onwards →

Supporting top-down theories?

More empirical work needed

Dataset Native Vowel Discr. Nonnative Vowel Discr. Word Recognition

Spin-offs in other areas

MetaVoice 

Interactive tools for community-augmented meta-analysis and
power analysis for experimental planning for voice patterns in neuropsychiatric disorders

MetaVoice

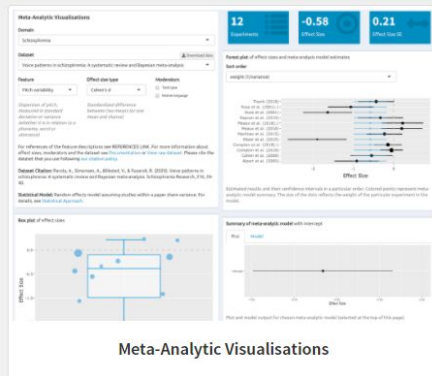
Analyses

Documentation

Publications

FAQ

About



You can explore the data with [interactive visualisation tools](#).

Explore the datasets, the statistical approach and learn how to contribute under [Documentation](#).

Voice Analysis

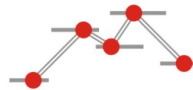
Investigating acoustic features of voice in neuropsychiatric disorders

4
Meta-analyses

73
Papers

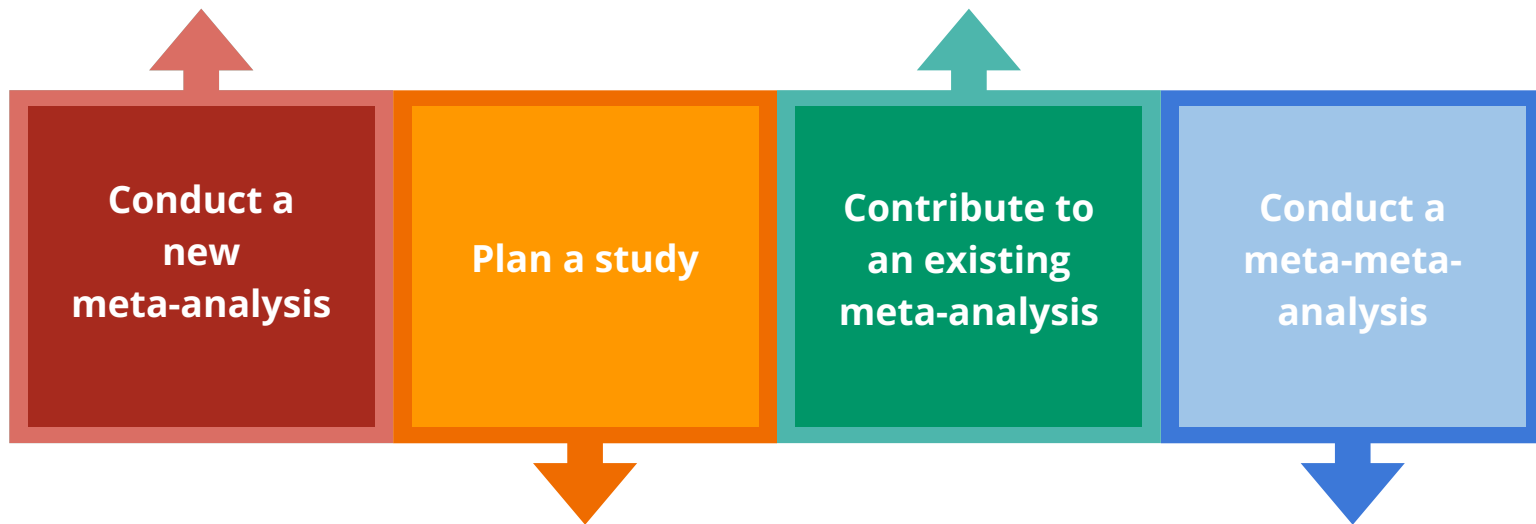
399
Effect sizes

3,359
Participants



Data validation/cleaning
metafor compatibility
Visualization

Data validation



**Conduct a
new
meta-analysis**

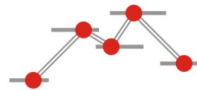
Plan a study

**Contribute to
an existing
meta-analysis**

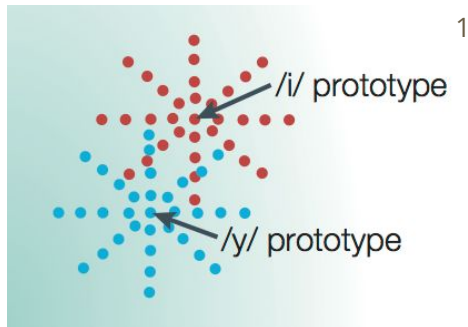
**Conduct a
meta-meta-
analysis**

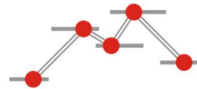
Power analysis

Data synthesis
metafor compatibility
Visualization



How and when do babies learn language?



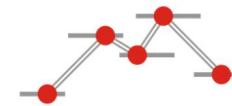


Acknowledgements



Many thanks to the MetaLab Team for their contributions: Erik Iverson and Sara El-Shawa for package development; the MetaLab leaders Christina Bergmann and Sho Tsuji and the governing board Alejandrina Cristia, Michael Frank and Molly Lewis. Thank you also to the many meta-analysis curators and contributors, the authors of original studies who shared data and the 45,000 participating babies and children, and their parents.

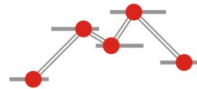




Thank you!

Research Synthesis and Big Data Virtual Conference
May 18th -21st 2021

MetaLab: <http://metalab.stanford.edu/>; metalabR repo: <https://github.com/langcog/metalabr/>; Email: gasparini.lorett@gmail.com



References

- Bergmann, C., Tsuji, S., & Cristia, A. (2017). Top-down versus bottom-up theories of phonological acquisition: A big data approach. *Interspeech 2017*, 2103–2107. <https://doi.org/10.21437/Interspeech.2017-1443>
- Bergmann, C., Tsuji, S., Piccinini, P. E., Lewis, M. L., Braginsky, M., Frank, M. C., & Cristia, A. (2018). Promoting replicability in developmental research through meta-analyses: Insights from language acquisition research. *Child Development*, 89(6), 1996–2009. <https://doi.org/10.1111/cdev.13079>
- Cristia, A., Tsuji, S., & Bergmann, C. (2020). *Theory evaluation in the age of cumulative science*. <https://doi.org/10.31219/osf.io/83kg2>
- Kuhl, P. (2004). Early language acquisition: cracking the speech code. *Nature Reviews Neuroscience*, 5, 831–843. <https://doi.org/10.1038/nrn1533>
- 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), 1–29. <https://doi.org/10.1177/2515245919900809>
- Nyholm Jensen, L., & Dwenger, N. (2020). *MetaVoice*. Retrieved 08 May 2021, from <http://metavoice.au.dk>
- Tsuji, S., Bergmann, C., & Cristia, A. (2014). Community-augmented meta-analyses: Toward cumulative data assessment. *Perspectives on Psychological Science*, 9(6), 661–665. <https://doi.org/10.1177/1745691614552498>
- Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, 36(3). <https://doi.org/10.18637/jss.v036.i03>