How-to Meta-Analysis

Katie Von Holzen
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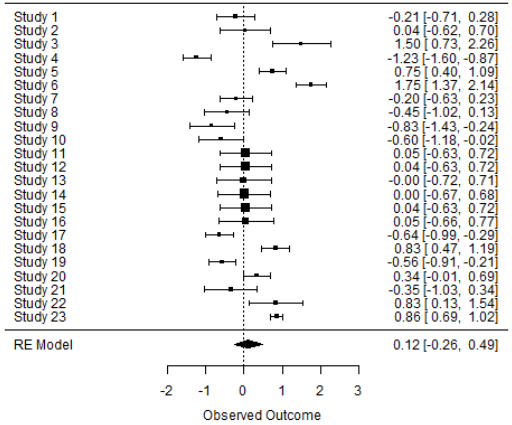
This tutorial

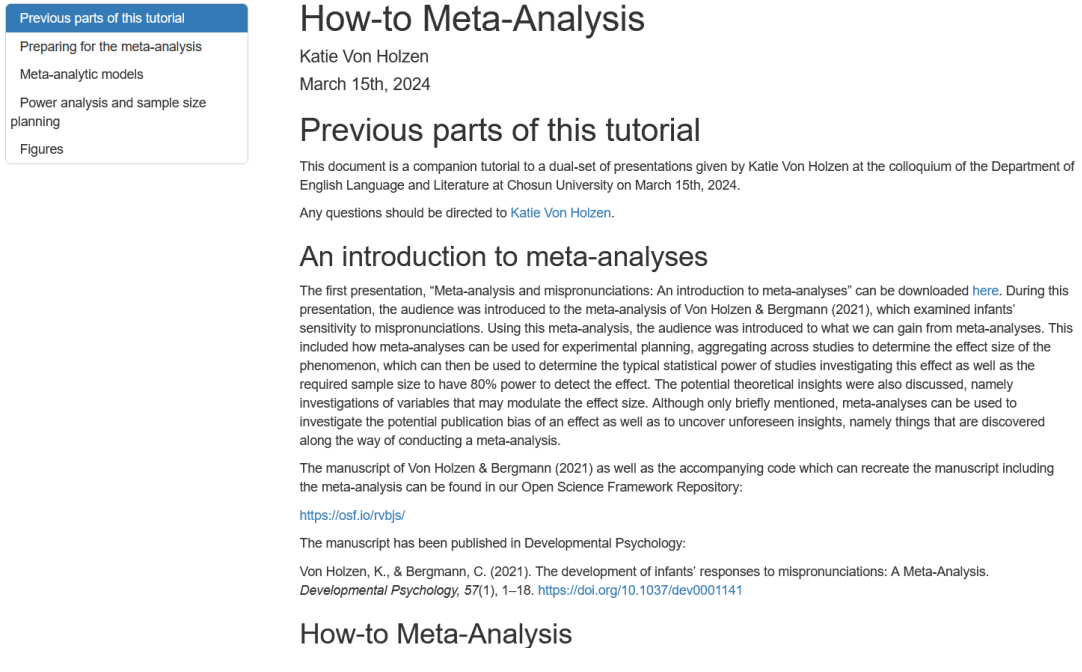
- Part A: Assembling a set of relevant studies
  - Already done: Von Holzen & Bergmann (2021)
- Part B: Create a database of relevant variables
  - Extract relevant information from Von Holzen et al. (2023)
  - Add to the data set
- Part C: Calculate the meta-analytic effect
  - Meta-analytic model of mispronunciation sensitivity
  - Power analysis and sample size planning
  - Forest plot



- Goal: That you have the tools to conduct a meta-analysis on your own

Follow along!

- https://kvonholzen.github.io/Tutorials_Intro_to_Meta_Analysis.html



Previous parts of this tutorial
Preparing for the meta-analysis
Meta-analytic models
Power analysis and sample size planning
Figures

How-to Meta-Analysis

Katie Von Holzen

March 15th, 2024

Previous parts of this tutorial

This document is a companion tutorial to a dual-set of presentations given by Katie Von Holzen at the colloquium of the Department of English Language and Literature at Chosun University on March 15th, 2024.

Any questions should be directed to Katie Von Holzen.

An introduction to meta-analyses

The first presentation, "Meta-analysis and mispronunciations: An introduction to meta-analyses" can be downloaded here. During this presentation, the audience was introduced to the meta-analysis of Von Holzen & Bergmann (2021), which examined infants' sensitivity to mispronunciations. Using this meta-analysis, the audience was introduced to what we can gain from meta-analyses. This included how meta-analyses can be used for experimental planning, aggregating across studies to determine the effect size of the phenomenon, which can then be used to determine the typical statistical power of studies investigating this effect as well as the required sample size to have 80% power to detect the effect. The potential theoretical insights were also discussed, namely investigations of variables that may modulate the effect size. Although only briefly mentioned, meta-analyses can be used to investigate the potential publication bias of an effect as well as to uncover unforeseen insights, namely things that are discovered along the way of conducting a meta-analysis.

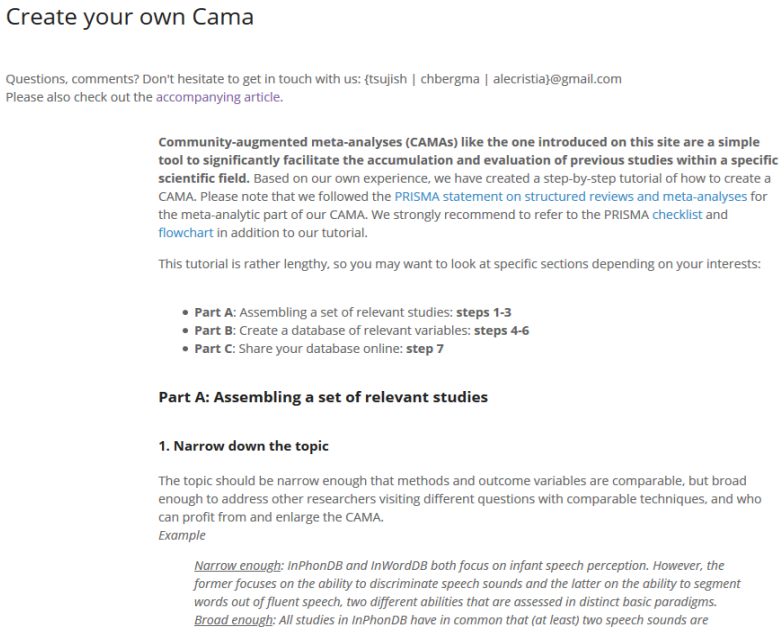
The manuscript of Von Holzen & Bergmann (2021) as well as the accompanying code which can recreate the manuscript including the meta-analysis can be found in our Open Science Framework Repository:

https://osf.io/rvbjs/

The manuscript has been published in Developmental Psychology:

Von Holzen, K., & Bergmann, C. (2021). The development of infants' responses to mispronunciations: A Meta-Analysis. *Developmental Psychology, 57*(1), 1–18. https://doi.org/10.1037/dev0001141

How-to Meta-Analysis



Create your own Cama

Questions, comments? Don't hesitate to get in touch with us: {tsujish | chbergma | alecristia}@gmail.com
Please also check out the accompanying article.

Community-augmented meta-analyses (CAMAs) like the one introduced on this site are a simple tool to significantly facilitate the accumulation and evaluation of previous studies within a specific scientific field. Based on our own experience, we have created a step-by-step tutorial of how to create a CAMA. Please note that we followed the PRISMA statement on structured reviews and meta-analyses for the meta-analytic part of our CAMA. We strongly recommend to refer to the PRISMA checklist and flowchart in addition to our tutorial.

This tutorial is rather lengthy, so you may want to look at specific sections depending on your interests:

- **Part A**: Assembling a set of relevant studies: **steps 1-3**
- **Part B**: Create a database of relevant variables: **steps 4-6**
- **Part C**: Share your database online: **step 7**

Part A: Assembling a set of relevant studies

1. Narrow down the topic

The topic should be narrow enough that methods and outcome variables are comparable, but broad enough to address other researchers visiting different questions with comparable techniques, and who can profit from and enlarge the CAMA.
Example

> *Narrow enough: InPhonDB and InWordDB both focus on infant speech perception. However, the former focuses on the ability to discriminate speech sounds and the latter on the ability to segment words out of fluent speech, two different abilities that are assessed in distinct basic paradigms.*
> *Broad enough: All studies in InPhonDB have in common that (at least) two speech sounds are*

https://sites.google.com/site/infantdbs/create-your-own-cama

Part A: Assembling a set of relevant studies

- Narrow down the topic
  - Mispronunciation Sensitivity
- Conduct a literature search
  - Google Scholar, Web of Science, ask experts
- Converge on final constraints
  - What studies are relevant to this question?
  - What information should they contain?

Part A: Assembling a set of relevant studies

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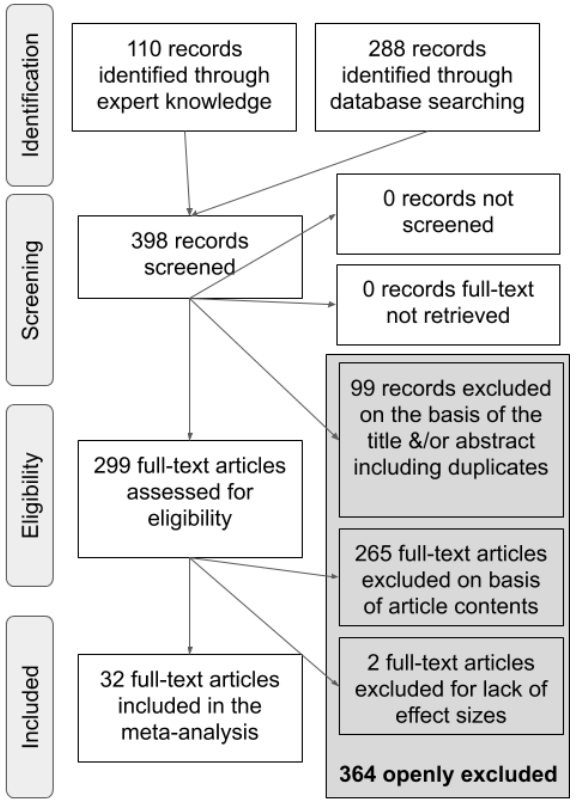

https://estech.shinyapps.io/prisma_flowdiagram/

Part A: Assembling a set of relevant studies

- Screened over 400 papers
  - Original data
  - Infants younger than 31 months
  - Familiar word recognition
  - Measured eye movements

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LANGUAGE LEARNING AND DEVELOPMENT
2023, VOL. 19, NO. 3, 303–322
https://doi.org/10.1080/15475441.2022.2071717

The Impact of Phonological Biases on Mispronunciation Sensitivity and Novel Accent Adaptation

Katie Von Holzen [a,b], Sandrien van Ommen [a,c], Katherine S. White [d], and Thierry Nazzi [a]

[a]Integrative Neuroscience and Cognition Center, CNRS (UMR 8002) & Université Paris Cité, Paris, France; [b]English Linguistics, Technische Universität Braunschweig, Germany; [c]Département de neurosciences fondamentales, Université de Genève, Genève, Switzerland; [d]Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada

Part A: Assembling a set of relevant studies

- Screened over 400 papers
  - Original data — collected it myself!
  - Infants younger than 31 months — 19-month-olds
  - Familiar word recognition — yes (French)
  - Measured eye movements — yes

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Part B: Create a database of relevant variables

- Create coding form and enter study information
  - ~Intro_to_Meta_analysis/literature/ highlightedVon Holzen et al. - 2023

Literature Source

Present study

In our study, we investigate how toddlers initially respond to vowel (Experiment 1) and consonant (Experiment 2) shifts (mispronunciations) in familiar words and whether brief, systematic exposure to such shifts can lead to adaptation and generalization to new items. In the paradigm employed here, word recognition is reflected by a significant increase in looking at the target following the presentation of the target word. Sensitivity to phonological changes is reflected by a reduction in the size of this increase for shifted compared to correct pronunciations. Toddlers in the present experiments either received no exposure to the systematically shifted phoneme prior to test (Control Groups) or did receive exposure to the systematically shifted phoneme prior to test (Accent Groups). Additionally, this exposure only presented half of the test words (labeled items), allowing for a test of whether toddlers in the Accent Groups generalize the shifted

Part B: Create a database of relevant variables

- Create coding form and enter study information
  - ~Intro_to_Meta_analysis/data/MA_Mispronunciations.xlsx

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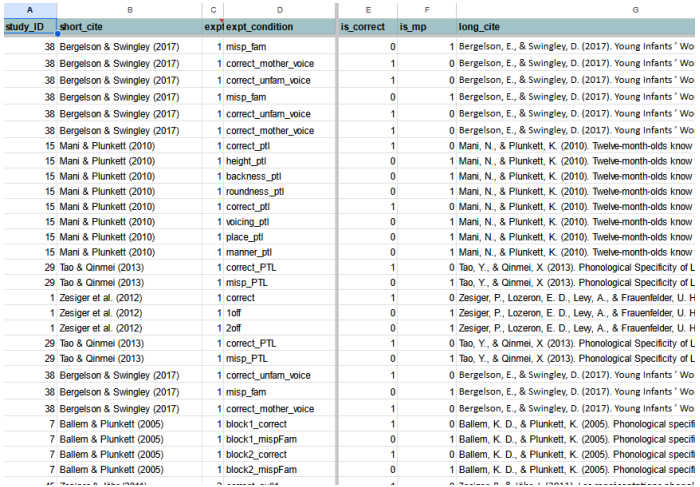
Tab: Eye-tracking Data



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38	Bergelson & Swingley (2017)	1	misp_fam	0	1	Bergelson, E., & Swingley, D. (2017). Young Infants ' Wo
38	Bergelson & Swingley (2017)	1	correct_mother_voice	1	0	Bergelson, E., & Swingley, D. (2017). Young Infants ' Wo
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29	Tao & Qinmei (2013)	1	correct_PTL	1	0	Tao, Y., & Qinmei, X (2013). Phonological Specificity of L
29	Tao & Qinmei (2013)	1	misp_PTL	0	1	Tao, Y., & Qinmei, X (2013). Phonological Specificity of L
1	Zesiger et al. (2012)	1	correct	1	0	Zesiger, P., Lozeron, E. D., Lewy, A., & Frauenfelder, U. H
1	Zesiger et al. (2012)	1	1off	0	1	Zesiger, P., Lozeron, E. D., Lewy, A., & Frauenfelder, U. H
1	Zesiger et al. (2012)	1	2off	0	1	Zesiger, P., Lozeron, E. D., Lewy, A., & Frauenfelder, U. H
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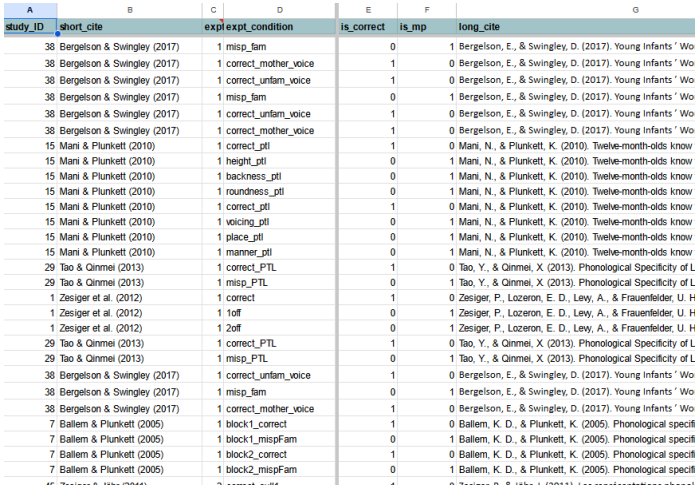

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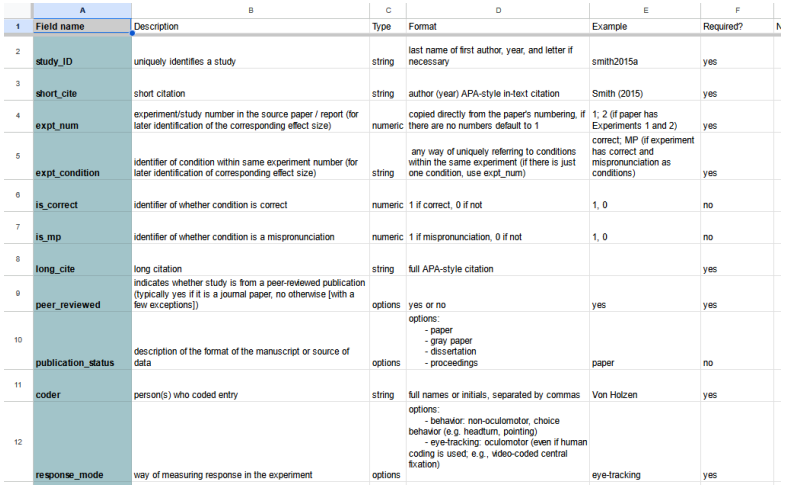

Field name	Description	Type	Format	Example	Required?
study_ID	uniquely identifies a study	string	last name of first author, year, and letter if necessary	smith2015a	yes
short_cite	short citation	string	author (year) APA-style in-text citation	Smith (2015)	yes
expt_num	experiment/study number in the source paper / report (for later identification of the corresponding effect size)	numeric	copied directly from the paper's numbering, if there are no numbers default to 1	1; 2 (if paper has Experiments 1 and 2)	yes
expt_condition	identifier of condition within same experiment number (for later identification of corresponding effect size)	string	any way of uniquely referring to conditions within the same experiment (if there is just one condition, use expt_num)	correct; MP (if experiment has correct and mispronunciation as conditions)	yes
is_correct	identifier of whether condition is correct	numeric	1 if correct, 0 if not	1, 0	no
is_mp	identifier of whether condition is a mispronunciation	numeric	1 if mispronunciation, 0 if not	1, 0	no
long_cite	long citation	string	full APA-style citation		yes
peer_reviewed	indicates whether study is from a peer-reviewed publication (typically yes if it is a journal paper, no otherwise [with a few exceptions])	options	yes or no	yes	yes
publication_status	description of the format of the manuscript or source of data	options	options: - paper - gray paper - dissertation - proceedings	paper	no
coder	person(s) who coded entry	string	full names or initials, separated by commas	Von Holzen	yes
response_mode	way of measuring response in the experiment	options	options: - behavior: non-oculomotor, choice behavior (e.g. headturn, pointing) - eye-tracking: oculomotor (even if human coding is used; e.g., video-coded central fixation)	eye-tracking	yes

Part B: Create a database of relevant variables

Literature Source

To cite this article: Katie Von Holzen, Sandrien van Ommen, Katherine S. White & Thierry Nazzi (2023) The Impact of Phonological Biases on Mispronunciation Sensitivity and Novel Accent Adaptation, Language Learning and Development, 19:3, 303-322, DOI: 10.1080/15475441.2022.2071717

Procedure

During the experiment, each toddler sat on their caregiver's lap inside a sound-attenuated booth. The caregiver was given noise-attenuating headphones which played instrumental music mixed with a woman speaking in order to mask the audio stimuli. Caregiver and toddler were seated approximately 60 cm in front of an Eyelink 1000 remote eye-tracker mounted below a BenQ computer display monitor (53 cm x 30 cm) which was attached to a movable arm. Two speakers were located on a table

Tab: Eye-tracking Data

			D	E	F	G	H	I	J	K
study_	short_cite	expt_n	expt_c	is_corr	is_mp	long_cite	peer_reviewed	publication_	coder	response_mode
48	Von Holzen et al. (2023)	1	Vaccent_s	1	0	Von Holzen, K., Van Ommen, S., White, K. S.,	yes	paper	Von Holzen	eye-tracking
48	Von Holzen et al. (2023)	1	Vaccent_s	1	0	Von Holzen, K., Van Ommen, S., White, K. S.,	yes	paper	Von Holzen	eye-tracking
48	Von Holzen et al. (2023)	1	Vaccent_s	0	1	Von Holzen, K., Van Ommen, S., White, K. S.,	yes	paper	Von Holzen	eye-tracking
48	Von Holzen et al. (2023)	1	Vaccent_s	0	1	Von Holzen, K., Van Ommen, S., White, K. S.,	yes	paper	Von Holzen	eye-tracking

Von Holzen et al. (2023)

Part B: Create a database of relevant variables

Tab: Codebook

dependent_measure	type of dependent measure used in experiment	options	options: - looking_time_change_pc - looking_time_change_prop - longest_look - looking_time_pc	longest_look	yes	see "Methods" tab for explanation
participant_design	indicates the groups that are the comparison of interest for effect size	options	- between: between two groups of participants - within_two: within one group of participants with two measurement points - within_one: within one group of participants with one measurement point	within_two	yes	within_two = comparison is pre to post; within_one = naming effect was calculated (post-pre)
same_infant	identifier of group of infants within a study (for determining if effect sizes in multiple rows are statistically independent)	string	any way of uniquely referring to group of infants within a study, if infants were tested in more than one condition, otherwise same as expt_condition	12_month_olds	yes	

Tab: Eye-tracking Data

		N	O	P	Q	R	S	T
exposure_phase	**method**	**dependent_measure**	**participant_design**	**same_infant**	**multip**	**native_lang**	**test_lang**	**infant_type**
familiarization	looking_while_listening	looking_time_change_pc	within_one	accent	0	French	native	typical
familiarization	looking_while_listening	looking_time_change_pc	within_one	accent	0	French	native	typical
familiarization	looking_while_listening	looking_time_change_pc	within_one	accent	0	French	native	typical
familiarization	looking_while_listening	looking_time_change_pc	within_one	accent	0	French	native	typical
familiarization	looking_while_listening	looking_time_change_pc	within_one	control	0	French	native	typical
familiarization	looking_while_listening	looking_time_change_pc	within_one	control	0	French	native	typical

Von Holzen et al. (2023)

Part B: Create a database of relevant variables

Literature Source

Methods

Participants

Forty-five 18–20-month-old toddlers were included in the final sample (mean age = 578.34 days, age range = 550–613 days, 17 females, 28 males). Twenty-two toddlers were tested in the Control group and 23 were tested in the Accent group. All participants were healthy, full-term French-learning monolinguals, with no reports of cognitive, visual, or hearing impairment, recruited from the Paris metropolitan area through birth lists. The socio-economic status of families participating in studies in this laboratory is typically upper-middle class.[2] All toddlers included in the final sample were exposed to the local, Parisian accent a majority of the time. Families were compensated by a participation diploma with their child's picture. The study was conducted in accordance with the Declaration of Helsinki, and the Ethics Committee of CERES (N◦ 2011-14, 18 October 2011) approved the protocol; parents gave written informed consent. An additional 16 participants were tested but not included in the final sample due to fussiness or refusing to wear the target sticker on their forehead (9), parental interference (2), exposure to a non-Parisian French accent (1), and not providing enough trials to be included in the analysis (4; details below).

Tab: Eye-tracking Data

	Y	Z	AA	AB	AC	AD	AE	AF	AG
same_infant	n_1	n_2	n_excluded_1	n_excl	n_fussi	gender_1	gender	mean_age_1	mean_age_months	min_age_1	max_age_1
accent	23		8			0.391304348		578.34	18.99934297	550	613
accent	23		8			0.391304348		578.34	18.99934297	550	613
accent	23		8			0.391304348		578.34	18.99934297	550	613
accent	23		8			0.391304348		578.34	18.99934297	550	613
control	22		8			0.363636364		578.34	18.99934297	550	613
control	22		8			0.363636364		578.34	18.99934297	550	613

Von Holzen et al. (2023)

Part B: Create a database of relevant variables

Literature Source

Table 2. Post hoc tests comparing the nested effects in models 2 and 3 to the chance value of 0.

Model	Group	Word Type	Pronunciation	EMM	SE	t-ratio	p-value	Cohen's d
Model 2	Accent		Standard	0.105	0.026	4.072	<.001	0.675
			Shifted	0.087	0.026	3.382	<.001	0.548
	Control		Standard	0.099	0.026	3.816	<.001	0.626
			Shifted	0.062	0.026	2.377	.0094	0.396
Model 3	Accent	Labeled	Standard	0.096	0.035	2.753	.0031	0.282
			Shifted	0.075	0.035	2.158	.0158	0.221
	Control		Standard	0.099	0.036	2.783	.0028	0.280
			Shifted	0.078	0.035	2.204	.0141	0.226
	Accent	Unlabeled	Standard	0.113	0.036	3.177	<.001	0.314
	Control		Shifted	0.101	0.036	2.775	.0029	0.268
			Standard	0.100	0.036	2.767	.0030	0.272
			Shifted	0.045	0.036	1.244	.1072	0.124

Tab: Eye-tracking Data

D	E	F	AR	AS	AT	AU	AV	AW	AX
expt_num	**expt_condition**	**is_correct**	**is_mp**	**x_type**	**chance**	**x_from**	**t**	**t_inter**	**F**	**d**
1	Vaccent_standard_labeled	1	0	proportion_change_pre_post	0		2.753			0.282
1	Vaccent_standard_unlabeled	1	0	proportion_change_pre_post	0		3.177			0.314
1	Vaccent_shifted_labeled	0	1	proportion_change_pre_post	0		2.158			0.221
1	Vaccent_shifted_unlabeled	0	1	proportion_change_pre_post	0		2.775			0.268
1	Vcontrol_standard_labeled	1	0	proportion_change_pre_post	0		2.783			0.28
1	Vcontrol_standard_unlabeled	1	0	proportion_change_pre_post	0		2.767			0.272
1	Vcontrol_shifted_labeled	0	1	proportion_change_pre_post	0		2.204			0.226
1	Vcontrol_shifted_unlabeled	0	1	proportion_change_pre_post	0		1.244			0.124
2	Caccent_standard_labeled	1	0	proportion_change_pre_post	0		3.145			0.592
2	Caccent_standard_unlabeled	1	0	proportion_change_pre_post	0		3.06			0.562
2	Caccent_shifted_labeled	0	1	proportion_change_pre_post	0		1.297			0.227

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Part B: Create a database of relevant variables

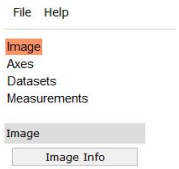
Tab: Codebook

x_1	mean of dependent variable for measure 1 (participant_design = within_one, within_two) or group 1 (participant_design = between)	numeric	if participant_design = between: maps onto group_name_1, mean_age_1, x_1, SD_1		yes
x_2	mean of dependent variable for measure 2 (participant_design = within_two) or group 2 (participant_design = between) or chance level (participant_design = within_one, if applicable)	numeric	second measure if participant_design = within_two; chance level if participant_design = within_one; if participant_design = between maps onto group_name_2, n_2, mean_age_2, SD_2		yes
SD_1	standard deviation of dependent variable for measure 1 (participant_design = within_one, within_two) or group 1 (participant_design = between)	numeric	if participant_design = between: maps onto group_name_1, mean_age_1, x_1, SD_1		yes
SD_2	standard deviation of dependent variable for measure 2 (participant_design = within_two) or group 2 (participant_design = between)	numeric			yes
SE_1	standard error of dependent variable for measure 1 (participant_design = within_one, within_two) or group 1 (participant_design = between)	numeric	if participant_design = between: maps onto group_name_1, mean_age_1, x_1, SD_1		no
SE_2	standard error of dependent variable for measure 2 (participant_design = within_two) or group 2 (participant_design = between)	numeric			no
SD_diff	standard deviation of the difference between two data sets: if standard error was reported instead of standard deviation, this value is the standard error multiplied by the square root of n_1	numeric			no

Von Holzen et al. (2023)

Cohen's *d* or means/standard dev's not available?

- Are they depicted in a figure?
  - Web Plot Digitizer: https://apps.automeris.io/wpd/



- Contact the authors
  - Ask them to send you values
  - Or ask to calculate the values yourself

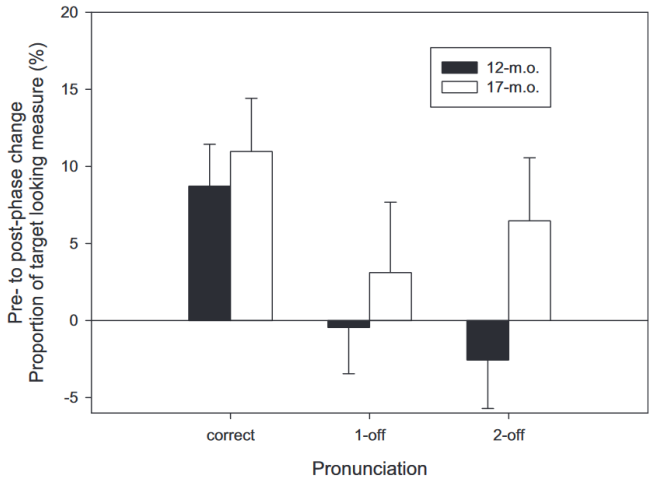


Figure 1 Mean pre- to post-naming change in the proportion of total looking measure in percent as a function of pronunciation (correct, incorrect with 1 [1-off] and incorrect with 2 [2-off] feature[s] mispronunciations) for 12- and 17-month-old infants.

Part B: Create a database of relevant variables

Literature Source

month-olds (Kern, 2003). We chose words such that the position of the vowel /a/ varied across words, occurring twice in monosyllabic words, twice in the final syllables of bisyllabic words, and twice in the initial syllables of bisyllabic words. In addition to ensuring the generalizability of effects across syllable positions, this also made the position of the target vowel comparable with that of the target consonant in Experiment 2. Six highly familiar, and highly picturable words were chosen to serve as the familiar word stimuli: *chat* "cat," *table* "table," *cheval* "horse," *fromage* "cheese," *ballon* "balloon," and *gateau* "cookie." For each standard pronunciation of /a/ with the correct [a] vowel,

Design). For the stimuli presented in the Test Phase, word tokens were produced with two carrier phrases (*Où est le/la X* – "Where is the X"; *Tu vois le/la X* – "You see the X"). For each of the two types of carrier phrases presented in the Test Phase, one token containing the standard and one containing the shifted pronunciation were selected. As expected, shifted vowels had lower F1 and higher F2 than the standard vowels (Table 1). Durations of the target words containing the standard and shifted vowels were similar.

Representative digital photographs were chosen for the visual stimuli. As in previous studies

The Exposure phase was followed by the Test phase. Test displays were one familiar target object paired with one unfamiliar, distractor object. Half of the familiar target objects had been labeled during the Exposure Phase (labeled), while the other half had not been labeled (unlabeled), allowing for a test of generalization to new items. Target-distractor pairings were the same for all toddlers. Each test trial began with a pre-naming phase, where the two objects were presented side-by-side in silence to establish baseline looking preferences, followed by a sentence, which instructed the toddler to look at the target object using one of the two carrier phrases (*Où est le/la X* – "Where is the X"; *Tu vois le/la X* – "You see the X"). The onset of the carrier phrase was timed such that the onset of the target label was always at 3000 ms. Following the onset of the target word, the display remained on the screen for the remainder of the trial, for a total trial time of six seconds. Figure 1 presents a schematic of an individual trial.

The Test Phase consisted of a total of 24 test trials, four per target-distractor pair. The target word was presented using the standard pronunciation in twelve trials and using the shifted pronunciation in the other twelve. Thus, the label for each familiar target object was heard twice with the standard

Tab: Eye-tracking Data

		BH	BI	BJ	BK	BL	BM	BN	BO	BP
num_trials	percent_MP	words	word_correct_and_MP	n_feat	type_f	mispron_location	within_sentence	sentence_context	object_pair	distractor_overlap
24	50	chat, table, cheval, fromage, ballon, gateau	yes	0	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	0	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	1	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	1	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	0	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	0	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	1	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	chat, table, cheval, fromage, ballon, gateau	yes	1	vowel	medial/coda	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	pain, porte, canape, lapin, poubelle, poussette	yes	0	consonant	onset/medial	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel
24	50	pain, porte, canape, lapin, poubelle, poussette	yes	0	consonant	onset/medial	yes	Ou ets le/la; Tu vois le/la	familiar_novel	novel

Von Holzen et al. (2023)

Part B: Create a database of relevant variables

Literature Source

Analysis

Average PTL was computed for the time in the trial before the target word was heard (pre-naming phase; 0–3000 ms) as well as after the target word was heard (post-naming phase; 3300–6000 ms). A delay of 300 ms was used in the post-naming phase to account for the amount of time needed for children's eyes to move in response to auditory stimuli (Canfield et al., 1997). For each trial, the mean PTL for the pre-naming phase was subtracted from the mean PTL for the post-naming phase to create the PTL-change measure, our dependent variable. Values above 0 indicate increased looking to the target in the post-naming phase, while values below 0 indicate increased looking to the distractor.

We computed a series of linear mixed effects models (lme4, Bates et al., 2015; lmerTest

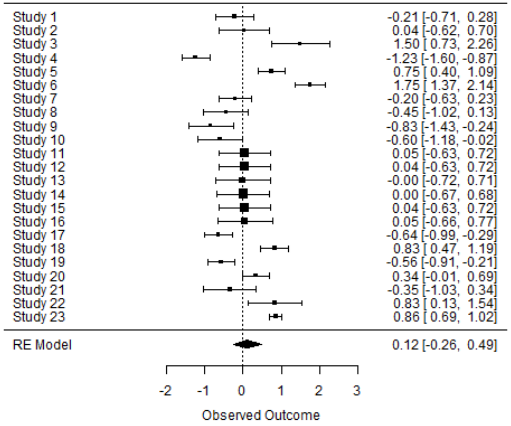
Tab: Eye-tracking Data

BQ	BR	BS	BT	BU
offset	**within_measure**	**pre_nam_dur**	**post_nam_dur**	**trial_length**
300	pre_post_naming_effect	3	2.7	6
300	pre_post_naming_effect	3	2.7	6
300	pre_post_naming_effect	3	2.7	6
300	pre_post_naming_effect	3	2.7	6
300	pre_post_naming_effect	3	2.7	6
300	pre_post_naming_effect	3	2.7	6

Von Holzen et al. (2023)

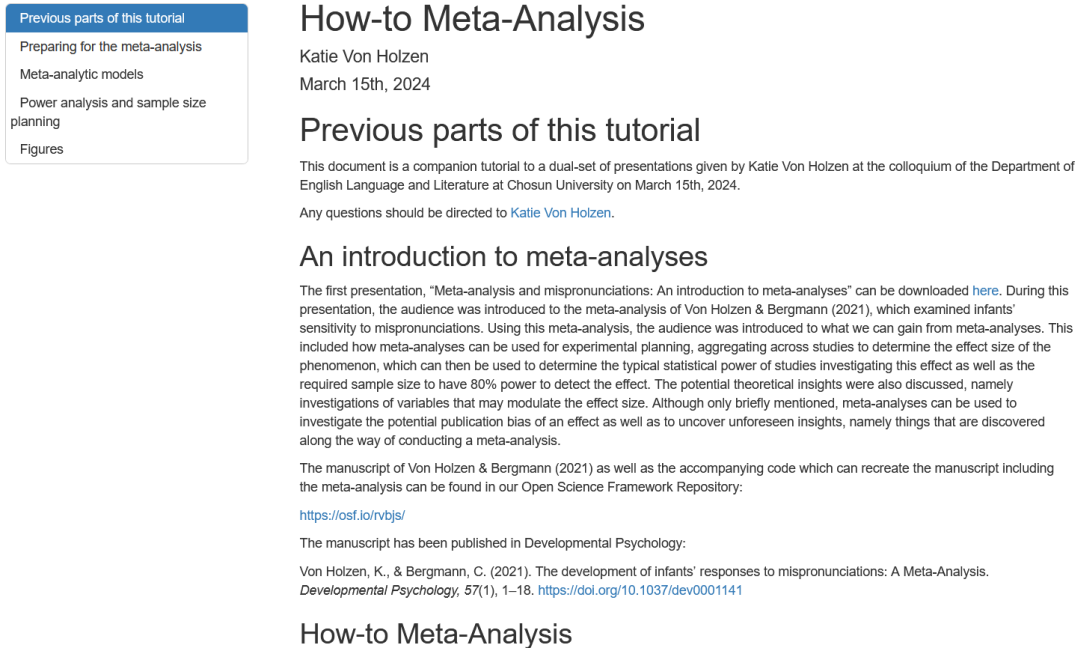
Part C: Calculate the meta-analytic effect

- Meta-analytic models of mispronunciation sensitivity
- Power analysis and sample size planning
- Forest plot



Part C: Calculate the meta-analytic effect

- https://kvonholzen.github.io/Tutorials_Intro_to_Meta_Analysis.html



How-to Meta-Analysis

Katie Von Holzen

March 15th, 2024

Previous parts of this tutorial

This document is a companion tutorial to a dual-set of presentations given by Katie Von Holzen at the colloquium of the Department of English Language and Literature at Chosun University on March 15th, 2024.

Any questions should be directed to Katie Von Holzen.

An introduction to meta-analyses

The first presentation, "Meta-analysis and mispronunciations: An introduction to meta-analyses" can be downloaded here. During this presentation, the audience was introduced to the meta-analysis of Von Holzen & Bergmann (2021), which examined infants' sensitivity to mispronunciations. Using this meta-analysis, the audience was introduced to what we can gain from meta-analyses. This included how meta-analyses can be used for experimental planning, aggregating across studies to determine the effect size of the phenomenon, which can then be used to determine the typical statistical power of studies investigating this effect as well as the required sample size to have 80% power to detect the effect. The potential theoretical insights were also discussed, namely investigations of variables that may modulate the effect size. Although only briefly mentioned, meta-analyses can be used to investigate the potential publication bias of an effect as well as to uncover unforeseen insights, namely things that are discovered along the way of conducting a meta-analysis.

The manuscript of Von Holzen & Bergmann (2021) as well as the accompanying code which can recreate the manuscript including the meta-analysis can be found in our Open Science Framework Repository:

https://osf.io/rvbjs/

The manuscript has been published in Developmental Psychology:

Von Holzen, K., & Bergmann, C. (2021). The development of infants' responses to mispronunciations: A Meta-Analysis. *Developmental Psychology, 57*(1), 1–18. https://doi.org/10.1037/dev0001141

How-to Meta-Analysis