

07 – Systematic Review



Dr. Seçkin Arslan



seckin.arslan@rug.nl



[@seckin1984](https://twitter.com/seckin1984)



UNIVERSITÉ
CÔTE D'AZUR

Systematic Review & meta-analysis

- ▶ Combines multiple (published) studies
- ▶ Integrate conclusions by analysing a group of studies
- ▶ With a pre-defined criteria for exhaustive search in a form of “**review**”



UNIVERSITÉ
CÔTE D'AZUR

Systematic Review & meta-analysis

- ▶ Review studies can be in different forms:
- ▶ **Narrative review**
 - ▶ Invited papers by established experts
 - ▶ Narrow in scope
 - ▶ Perspective / historical issues over a topic of interest
 - ▶ Narrative reviews are biased (and usually contains no statistical processing)



Systematic Review & meta-analysis

- ▶ Review studies can be in different forms:
- ▶ **Vote counting / probability combining**
 - ▶ Significant (+/-) vs. non-significant (or counting p-values)
 - ▶ Disregards sample size
 - ▶ Hard to understand magnitude / effect size
 - ▶ Hedges & Olkin (1980) argued "statistical power decreases as number of studies increase"
 - ▶ Not so informative



Systematic Review & meta-analysis

- ▶ Review studies can be in different forms:
- ▶ **Systematic review (meta-analysis)**
 - ▶ Systematic, structured, objective
 - ▶ Document all steps involved in review (literature, coding, analysis)



UNIVERSITÉ
CÔTE D'AZUR

Systematic Review & meta-analysis

TABLE 1.1. Comparison of methods of research synthesis.

Characteristics of the review type	Narrative review	Vote counting	Combining probabilities	Meta-analysis
Imposes restrictions on the type of studies that can be used in review	No	No	No	Yes
Interprets study outcome based on its statistical significance	Yes	Yes	Yes	No
Takes into account sample size and statistical power of the individual studies being combined	No	No	Yes	Yes
Assesses statistical significance of the mean (overall) effect (i.e., whether it is significantly different than zero)	No	No	Yes	Yes
Assesses the magnitude of the mean effect	No	No	No	Yes
Allows analysis of sources of variation among studies	No	No	No	Yes



Systematic Review & meta-analysis

- ▶ When do we conduct a meta-analysis?
 - ▶ considerable amount of studies on the topic
 - ▶ Uncertain or conflicting results
 - ▶ Many studies but with small sample sizes



UNIVERSITÉ
CÔTE D'AZUR

Systematic Review & meta-analysis

► **Systematic review**

"A review that strives to comprehensively identify, appraise, and synthesize all the relevant studies on a given topic."

► **Meta-analysis**

"A review that uses a specific statistical technique for synthesizing the results of several studies into a single quantitative estimate (i.e. a summary effect size)" (is a statistical technique)



UNIVERSITÉ
CÔTE D'AZUR

Systematic Review & meta-analysis

- ▶ Systematic review must include :
 - ▶ **Systematic and extensive searches** to identify all the relevant published and unpublished literature
 - ▶ **Study selection according to predefined eligibility criteria**
 - ▶ **Assessment of the risk of bias** for included studies
 - ▶ Presentation of the findings in an independent manner
 - ▶ Discussion of the limitations of the evidence and of the review.



Systematic Review & meta-analysis

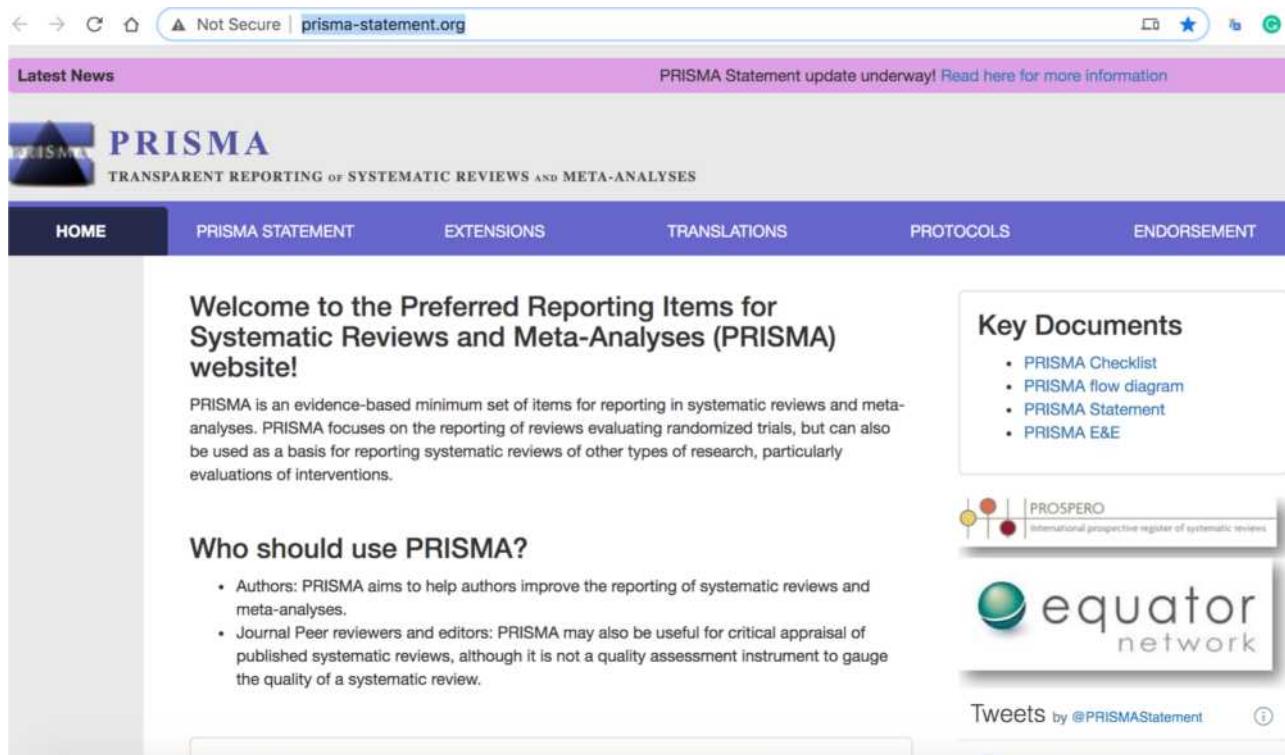
- ▶ Meta-analysis

- ▶ Can take long time to complete (I started one in 2017 still under review)
- ▶ Publication biases
- ▶ Heterogeneity (gathering different conditions, studies, people)
- ▶ Coping with missing data
- ▶ Do not have to be medical or be with large number of studies!



Systematic Review & meta-analysis

► Meta-analysis is a big business.



The screenshot shows the PRISMA website homepage. At the top, there's a navigation bar with links for HOME, PRISMA STATEMENT, EXTENSIONS, TRANSLATIONS, PROTOCOLS, and ENDORSEMENT. Below the navigation, a main content area features a welcome message: "Welcome to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) website!". It explains that PRISMA is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses. To the right, there's a "Key Documents" section listing the PRISMA Checklist, PRISMA flow diagram, PRISMA Statement, and PRISMA E&E. Below this are logos for PROSPERO (International prospective register of systematic reviews) and equator network. At the bottom, there's a "Tweets by @PRISMAStatement" feed.

<http://prisma-statement.org/>

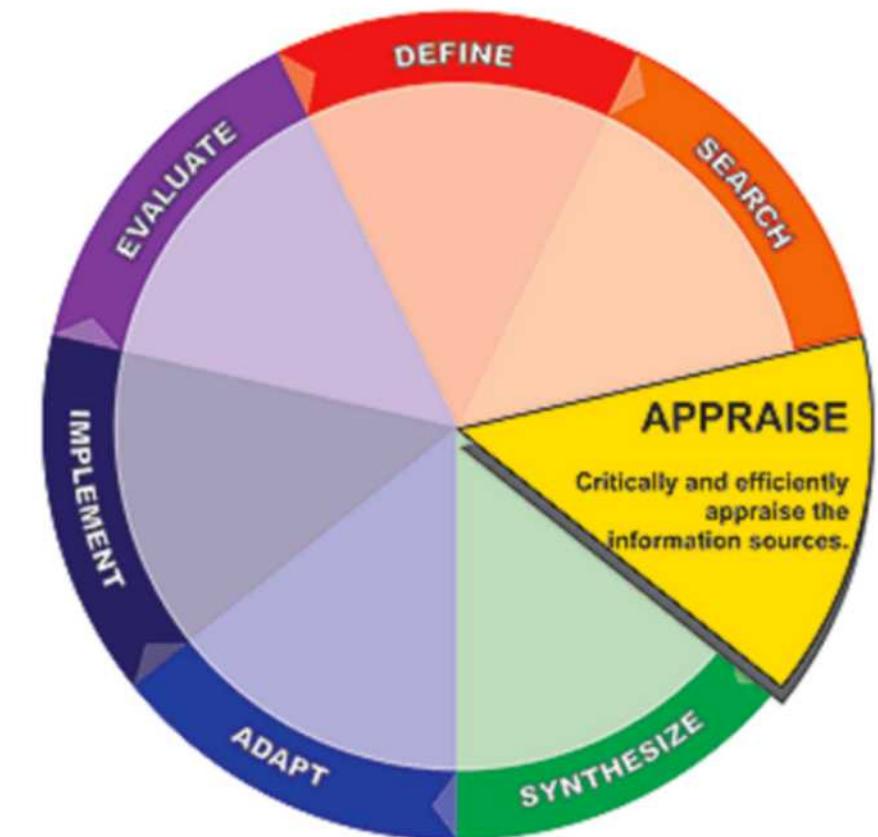
You can register your protocol with PRISMA!!



UNIVERSITÉ
CÔTE D'AZUR

Systematic Review & meta-analysis

- Meta-analysis
 - **Formulating the problem**
 - **Literature search**
 - Gathering information from studies
 - **Evaluating the quality of studies**
 - **Analyzing and integrating**
 - Interpreting the evidence
 - Presenting the results



Formulating the problem

- ▶ Since when (e.g. studies starting from 1990...)
- ▶ Which designs and techniques (studies using eye-movement monitoring)
- ▶ Which outcome variables (ratios, proportions, etc.)



UNIVERSITÉ
CÔTE D'AZUR

Formulating the problem

- ▶ Develop answerable questions!! **The PICO Model**
 1. **Patient, Population, or Problem**
 2. **Intervention, Prognostic factor, Exposure**
 3. **Comparison**
 4. **Outcome**



UNIVERSITÉ
CÔTE D'AZUR

Formulating the problem

Patient, Population, or Problem

- ▶ How is the disease/condition defined?
- ▶ What are the most important characteristics that describe the people?
- ▶ Are there any relevant demographic factors (eg. age, sex, ethnicity)?
- ▶ What is the setting (eg. hospital, community, etc)?
- ▶ Who should make the diagnosis?



Formulating the problem

Intervention and comparison

- ▶ What are the experimental and control (comparator) interventions of interest?
- ▶ Does the intervention have variations (eg. dosage/intensity, mode of delivery, personnel who deliver it, frequency of delivery, duration of delivery, timing of delivery)?
- ▶ Are all variations to be included (for example is there a critical dose below which the intervention may not be clinically appropriate)?



Formulating the problem

Outcome

- ▶ Ensure that outcomes cover potential as well as actual adverse effects.
- ▶ Consider outcomes relevant to all potential decision makers, including economic data.
- ▶ Consider the type and timing of outcome measurements.



Literature search

- Which “**sources**” (databases) and which “**key-words**”



WEB OF SCIENCE

Scopus®

PubMed

Google
Scholar

ScienceDirect®

R^G

SciELO

CNKI
www.cnki.net
中国知识基础设施工程

NON SOLUS
Elsevier



JNIVERSITÉ
CÔTE D'AZUR

Scopus

PubMed

Google
Scholar

ScienceDirect

ResearchG...

SciELO

CNKI

Elsevier

Literature search

- Which “**sources**” (databases) and which “**key-words**”



National Library of Medicine
National Center for Biotechnology Information

Log in

working memory

Advanced Create alert Create RSS User Guide

Save Email Send to

Sorted by: Best match Display options

MY NCBI FILTERS

RESULTS BY YEAR

1949 2021

55,397 results

Working Memory: A Selective Review.
Kent PL.
Appl Neuropsychol Child. 2016 Jul-Sep;5(3):163-72. doi: 10.1080/21622965.2016.1167491.
PMID: 27191213 Review.
A literature search using PsychNet Gold was conducted using the terms **working memory**. In addition, the writer reviewed recommendations from a sampling of recent neuropsychology texts in regard to the assessment of attention and **working memory**, as well ...



UNIVERSITÉ
CÔTE D'AZUR

Literature search

- Which “**sources**” (databases) and which “**key-words**”



Google Scholar

working memory

About 5.290.000 results (0,05 sec)

Articles

Any time

Since 2021

Since 2020

Since 2017

Custom range...

Sort by relevance

Sort by date

include patents

include citations

Create alert

Working memory
AD Baddeley, G Hitch - Psychology of learning and motivation, 1974 - Elsevier
Publisher Summary This chapter presents a body of new experimental evidence, which provides a firm basis for the working memory hypothesis. The chapter presents a series of experiments on the role of memory in reasoning, language comprehension, and learning ...
☆ 99 Cited by 17572 Related articles All 4 versions

Working memory
A Baddeley - Science, 1992 - science.sciencemag.org
The term working memory refers to a brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning. This definition has evolved from the concept of a a ...
☆ 99 Cited by 26438 Related articles All 19 versions

[HTML] Working memory
A Baddeley - Current biology, 2010 - Elsevier
Working memory refers to the system or systems that are assumed to be necessary in order to keep things in mind while performing complex tasks such as reasoning, comprehension and learning. Over the last 30 years, the concept of working memory has been increasingly ...
☆ 99 Cited by 1252 Related articles All 14 versions



UNIVERSITÉ
CÔTE D'AZUR

Literature search

- ▶ Which “**sources**” (databases) and which “**key-words**”



Imagine you are doing a meta-analysis on working memory impairments in children with developmental disorders , what key-words would you use?



UNIVERSITÉ
CÔTE D'AZUR

Literature search

- ▶ Which “**sources**” (databases) and which “**key-words**”
- ▶ Identify synonyms and related terms
 - What terminology is used internationally?
 - Are there spelling differences in UK English and US English words?
 - Are there any colloquial terms or phrases used?



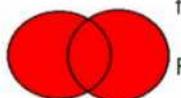
Literature search

• Boolean Operators

Boolean operators (OR, AND, NOT) allow you to link terms together, either to widen a search or to exclude terms from your search results.

Use to broaden your search, increasing the number of references retrieved. Use "OR" to search for synonyms and related terms for each concept within a research question.

OR

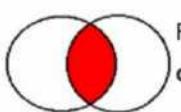


For example, when searching for the concept "exercise based rehabilitation" you might use the following terms:

rehabilitation OR exercise OR exercise therapy OR sports OR exertion OR physical training OR aerobics OR kinesiotherapy

Used to narrow a search, therefore decreasing the number of references.

AND



For example, searching for:

coronary heart disease AND Asian Americans

Would retrieve just those references covering both topics.

Used to narrow a search, therefore decreasing the number of references.

For example:

dogs NOT sheep

Would retrieve references dealing with females, but not those which discuss males. Caution should be exercised when using NOT,

In the example above, research dealing with both dogs and sheep would be excluded from the search results.



UNIVERSITÉ
CÔTE D'AZUR

Literature search

- ▶ Which “**sources**” (databases) and which “**key-words**”



Let's think once again about the keywords

Imagine you are doing a meta-analysis on working memory impairments in children with developmental disorders , what key-words would you use?



UNIVERSITÉ
CÔTE D'AZUR

Evaluating the quality of studies

- ▶ Identify inclusion criteria for your systematic review

 PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	

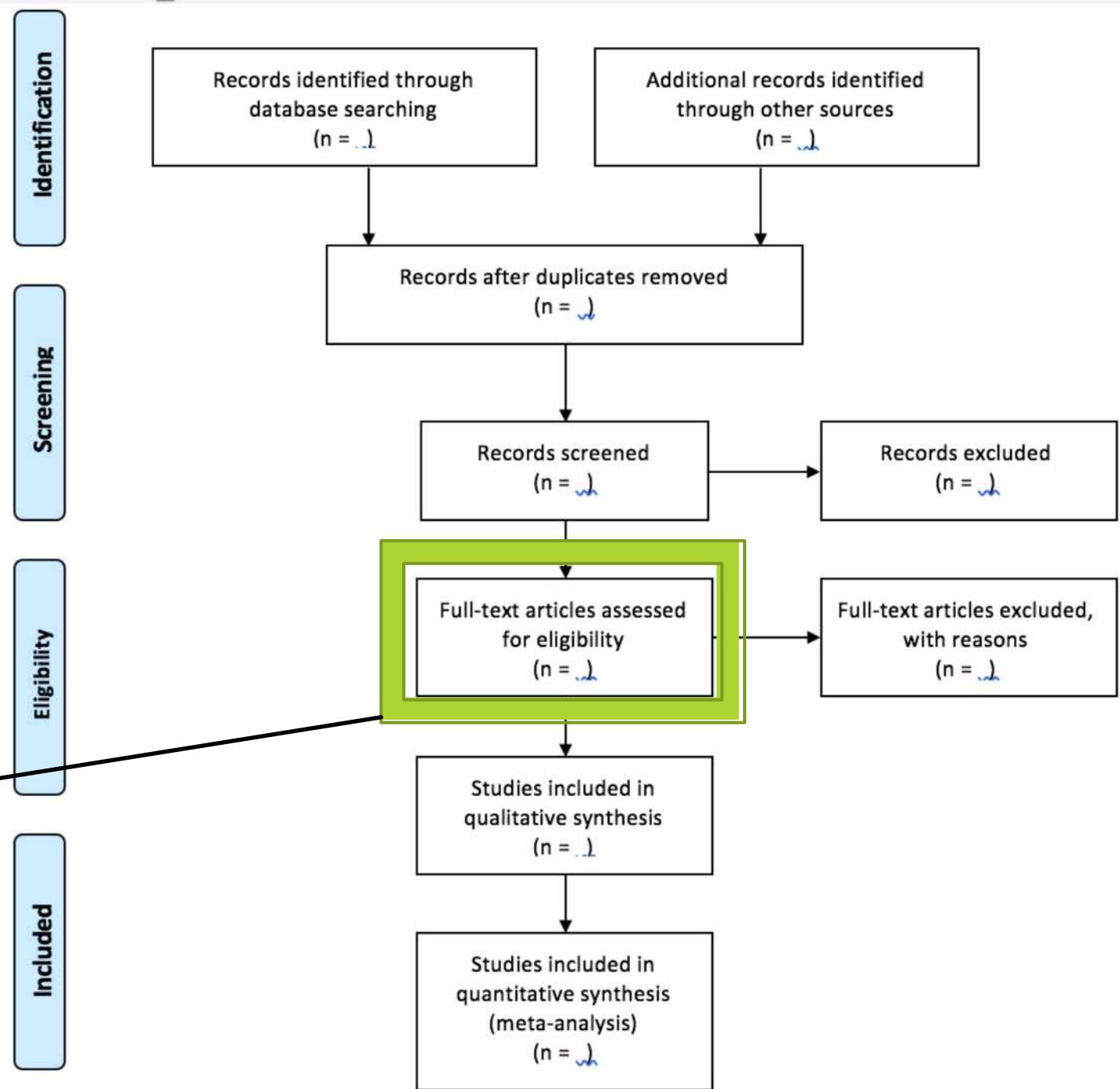


UNIVERSITÉ
CÔTE D'AZUR

Evaluating the

- ▶ Identify inclusion crit

This is the important step,
And often very subjective
That's why it is important to register
Protocol first !!



Evaluating the quality of studies

► Identify inclusion criteria for your systematic review

You should next think about the limits you intend to apply to your search.

Criteria	Questions to Ask	Advise from the <i>Cochrane Handbook for Systematic Reviews of Interventions</i> (2008, p. 134)
Time Period	Will your review be restricted by year of publication, or is it important that you cover all years?	"Date restrictions should be applied only if it is known that relevant studies could only have been reported during a specific time period, for example if the intervention was only available after a certain time point."
Language	Should you restrict to English language publications only?	"Whenever possible review authors should attempt to identify and assess for eligibility all possibly relevant reports of trials irrespective of language of publication. No language restrictions should be included in the search strategy."
Publication Type	Are you restricting your search by publication type?	"Format restrictions such as excluding letters are not recommended because letters may contain important additional information relating to an earlier trial report or new information about a trial not reported elsewhere."
Geographic Considerations	Are there any geographic considerations to include in your search strategy?	For example, if you were researching Chinese herbal medicine you would need to consult Chinese literature.



UNIVERSITÉ
CÔTE D'AZUR

Analysing and integrating

- ▶ Once you are done with the search and evaluation, the target variables can be “**coded**” or “**extracted**”.

- ▶ Study-based meta analysis or individual-data meta-analysis?
- ▶ Effect sizes, means, proportions
- ▶ Individual factors (number of subjects, ages, etc.)
- ▶ Study descriptors (publication year, authors)

- ▶ Coding reliability !!! **How can we achieve reliable coding?**

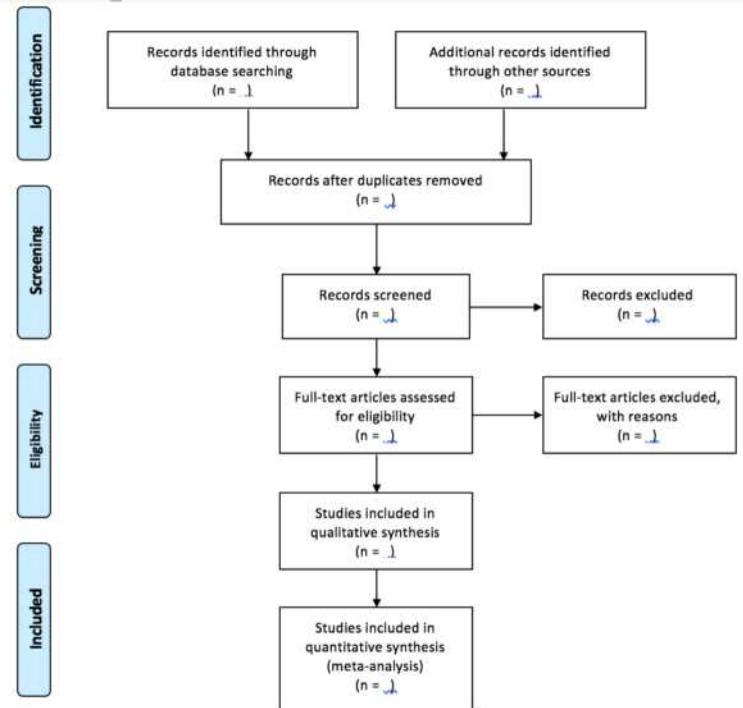
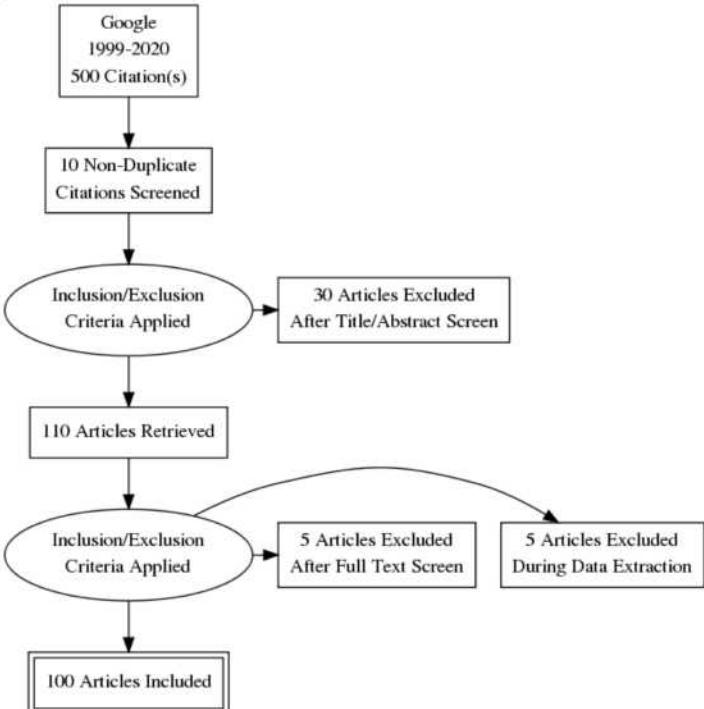


Analysing and integrating



<http://prisma.thetacollaborative.ca/>

You can generate flow chart easily online



UNIVERSITÉ
CÔTE D'AZUR

07 – An example meta-analysis: pronoun impairments in aphasia



Arslan, Devers, Martínez-Ferreiro (under revision)



Dr. Seçkin Arslan



seckin.arslan@rug.nl

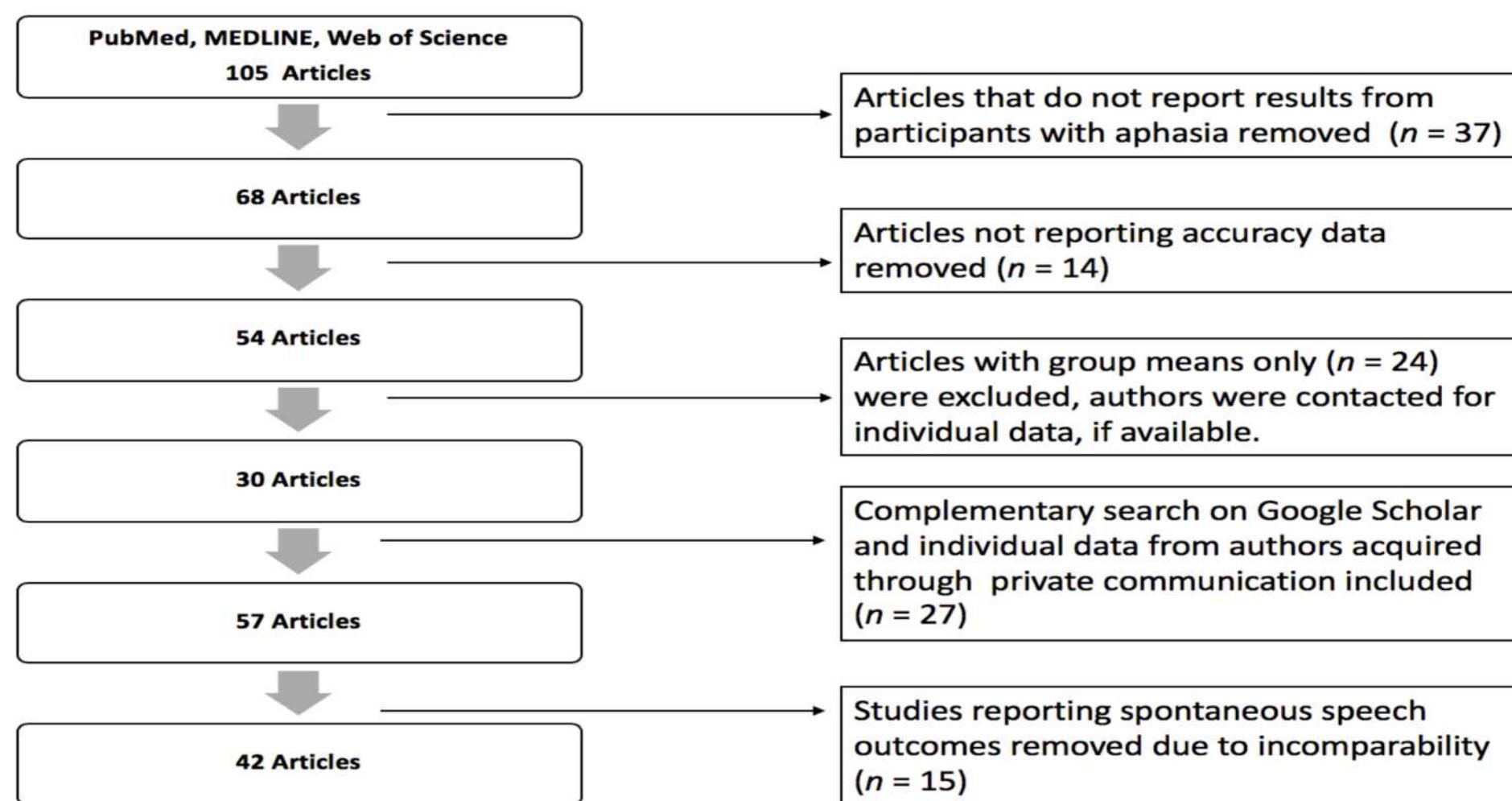


@seckin1984



UNIVERSITÉ
CÔTE D'AZUR

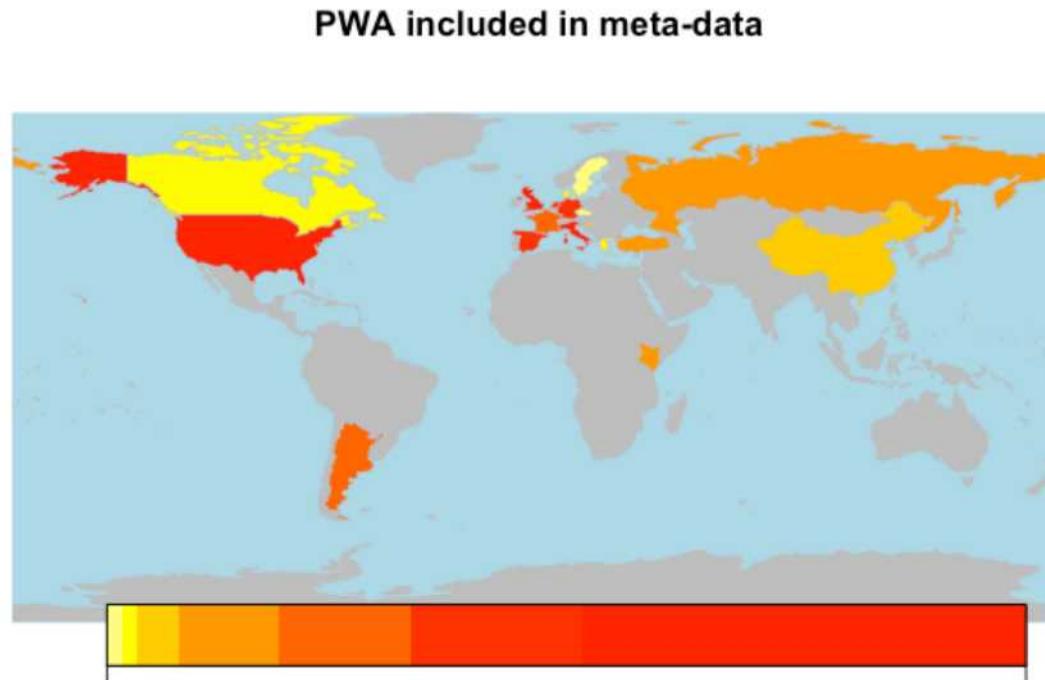
A Meta-analysis of pronoun impairments



UNIVERSITÉ
CÔTE D'AZUR

A Meta-analysis of pronoun impairments

- ▶ 42 peer-reviewed studies across 16 languages comprising **474 PWA** were included

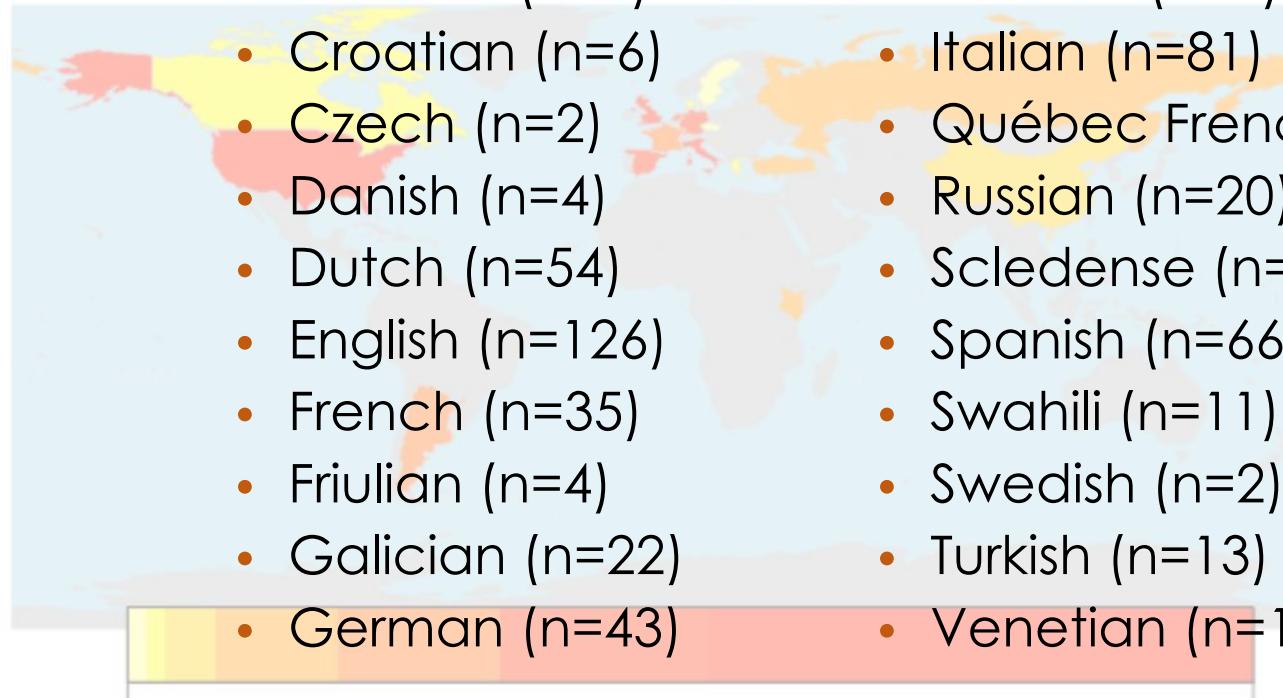


UNIVERSITÉ
CÔTE D'AZUR

A Meta-analysis of pronoun impairments

► 42 peer-reviewed studies across 26 languages comprising 474 PWA were included in this preliminary review

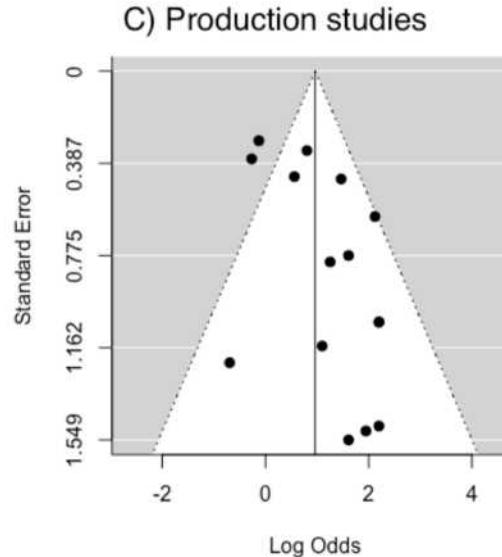
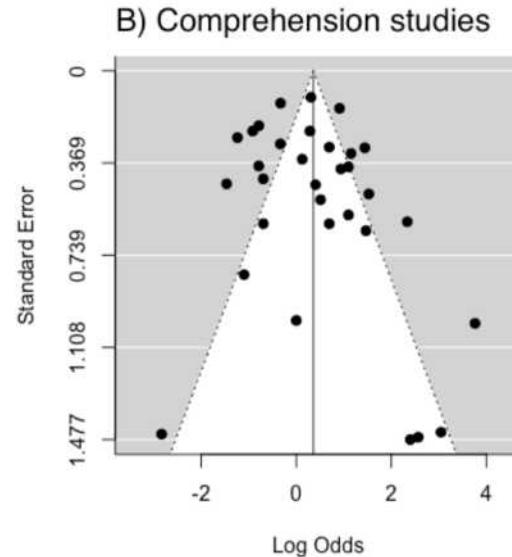
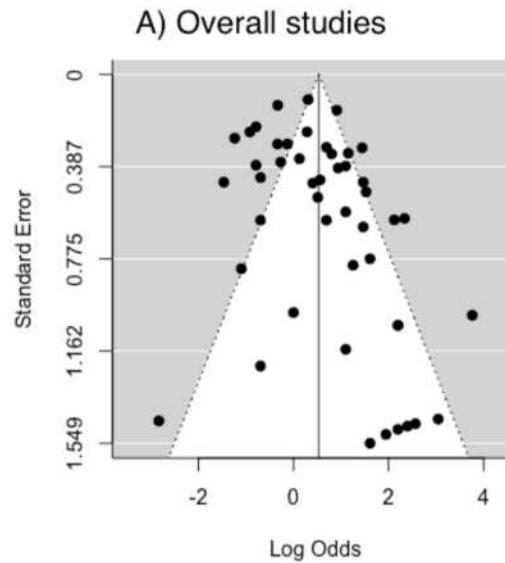
- Cantonese (n=10)
- Catalan (n=6)
- Croatian (n=6)
- Czech (n=2)
- Danish (n=4)
- Dutch (n=54)
- English (n=126)
- French (n=35)
- Friulian (n=4)
- Galician (n=22)
- German (n=43)
- Greek (n=5)
- Hebrew (n=1)
- Italian (n=81)
- Québec French (n=5)
- Russian (n=20)
- Scledense (n=2)
- Spanish (n=66)
- Swahili (n=11)
- Swedish (n=2)
- Turkish (n=13)
- Venetian (n=1)



UNIVERSITÉ
CÔTE D'AZUR

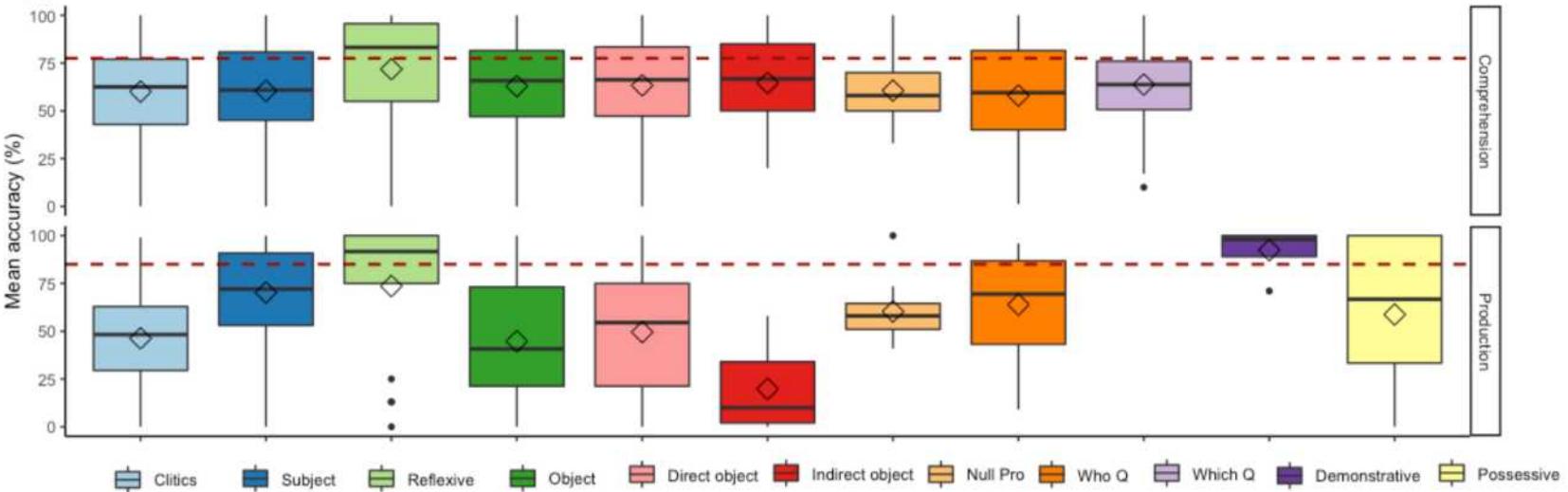
Meta-analytic screening

- ▶ conducted using the *metafor* package in R [28].

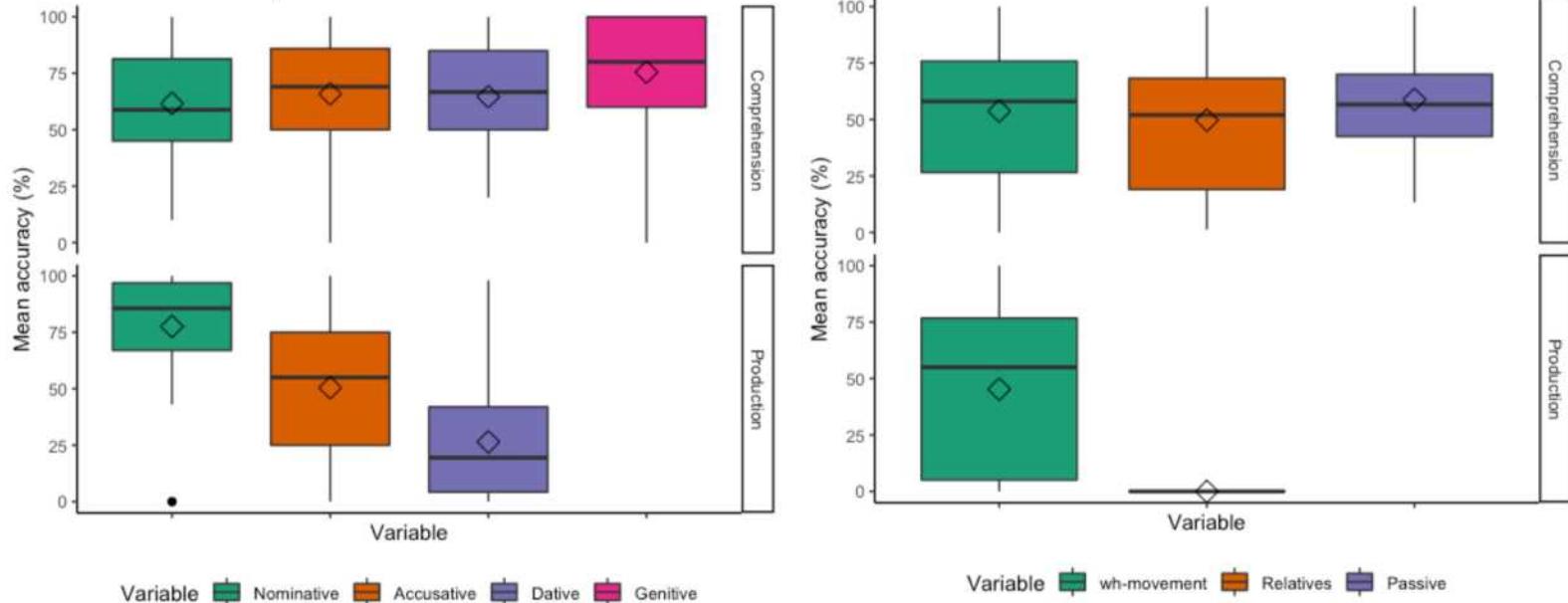




A Pronoun variables



B Case marked on pronouns

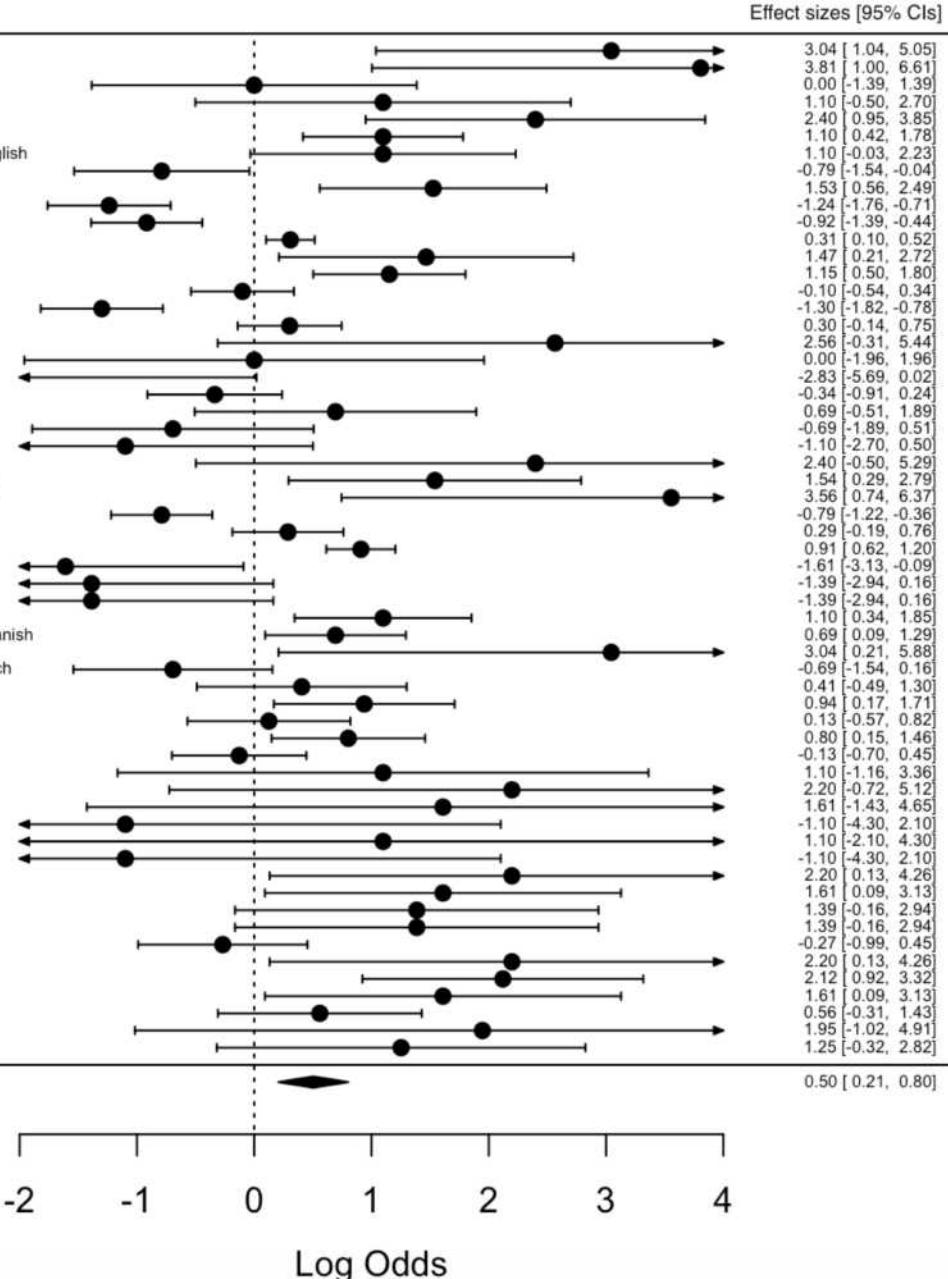


UNIVERSITÉ
CÔTE D'AZUR

Authors (year), Task modality, Language

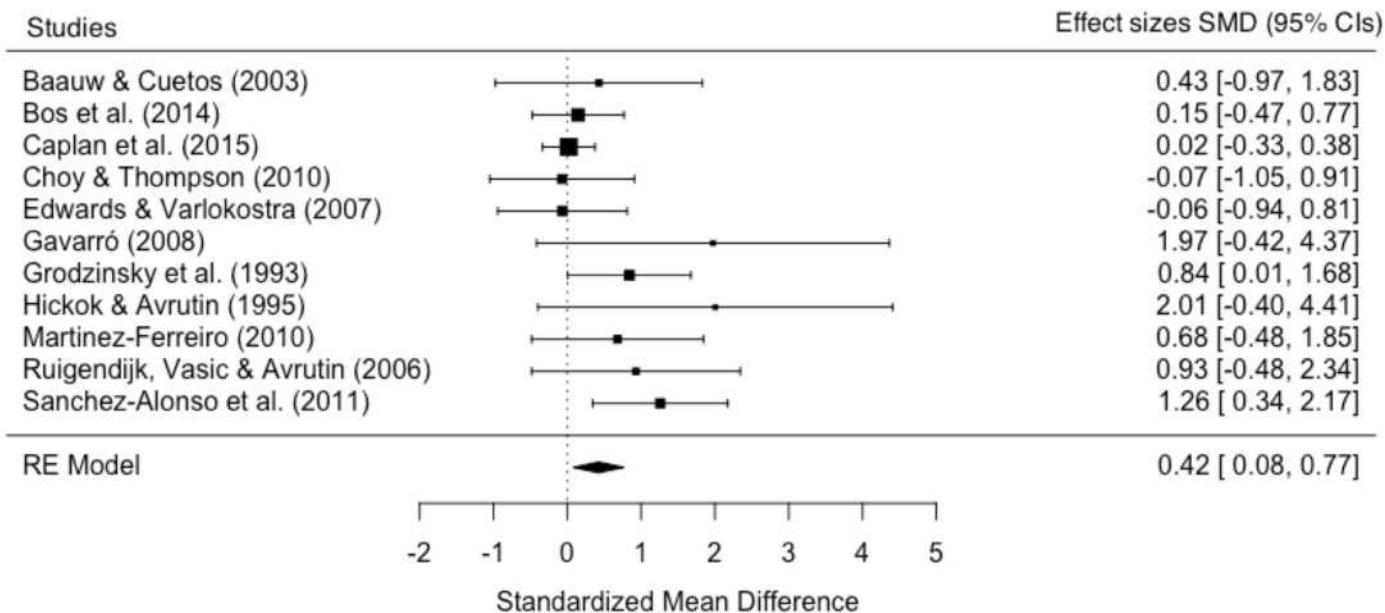
Abuom et al. (2013), Comprehension, English
 Abuom et al. (2013), Comprehension, Swahili
 Arslan & Felser (2017), Comprehension, German
 Arslan & Felser (2017), Comprehension, Turkish
 Arslan et al. (2017), Comprehension, German
 Arslan et al. (2017), Comprehension, Turkish
 Avrutin, Lubarsky & Greene (1999), Comprehension, English
 Baauw & Cuetos (2003), Comprehension, Spanish
 Baauw et al. (2011), Comprehension, Spanish
 Bos et al. (2014), Comprehension, Russian
 Caplan et al. (2007), Comprehension, English
 Caplan et al. (2015), Comprehension, English
 Choy & Thompson (2010), Comprehension, English
 Edwards & Varlokstra (2007), Comprehension, English
 Friederici et al. (1991), Comprehension, Dutch
 Friederici et al. (1991), Comprehension, French
 Friederici et al. (1991), Comprehension, German
 Fyndanis et al. (2010), Comprehension, Greek
 Garraffa (2008), Comprehension, Italian
 Gavarró (2008), Comprehension, Catalan
 Grodzinsky et al. (1993), Comprehension, English
 Hanne et al. (2016), Comprehension, German
 Hickok & Avrutin (1995), Comprehension, English
 Hickok & Avrutin (1996), Comprehension, English
 Jarema & Friederici (1994), Comprehension, French
 Juncos-Rabadan et al. (2009), Comprehension, Galician
 Juncos-Rabadan et al. (2009), Comprehension, Spanish
 Kljajevic & Murasugi (2010), Comprehension, Croatian
 Kljajevic et al. (2019), Comprehension, Spanish
 Luzzatti et al. (2001), Comprehension, Italian
 Martínez-Ferreiro (2010), Comprehension, Catalan
 Martínez-Ferreiro (2010), Comprehension, Galician
 Martínez-Ferreiro (2010), Comprehension, Spanish
 Neuhaus & Penke (2008), Comprehension, German
 Nyvad, Christensen & Vinken (2014), Comprehension, Danish
 Rigalleau & Caplan (2004), Comprehension, English
 Rügendijk, Vasic & Avrutin (2006), Comprehension, Dutch
 Salis & Edwards (2008), Comprehension, English
 Thompson et al. (1999), Comprehension, English
 Van der Meulen (2004), Comprehension, French
 Caplan et al. (2007), Production, English
 de Roo (2003), Production, Dutch
 DeBleser & Luzzatti (1994), Production, Italian
 Fyndanis et al. (2010), Production, Greek
 Garraffa & Grillo (2008), Production, Italian
 Goral, Levy & Kastl (2010), Production, English
 Goral, Levy & Kastl (2010), Production, French
 Goral, Levy & Kastl (2010), Production, Hebrew
 Law & Cheng (2002), Production, Cantonese
 Martínez-Ferreiro (2010), Production, Catalan
 Martínez-Ferreiro (2010), Production, Galician
 Martínez-Ferreiro (2010), Production, Spanish
 Neuhaus & Penke (2008), Production, German
 Reyes & Bastiaanse (2013), Production, Spanish
 Rossi (2007), Production, Italian
 Rossi (2015), Production, Italian
 Sanchez-Alonso et al. (2011), Production, Spanish
 Shankweiler et al. (2010), Production, English
 Van der Meulen (2004), Production, French

RE Model



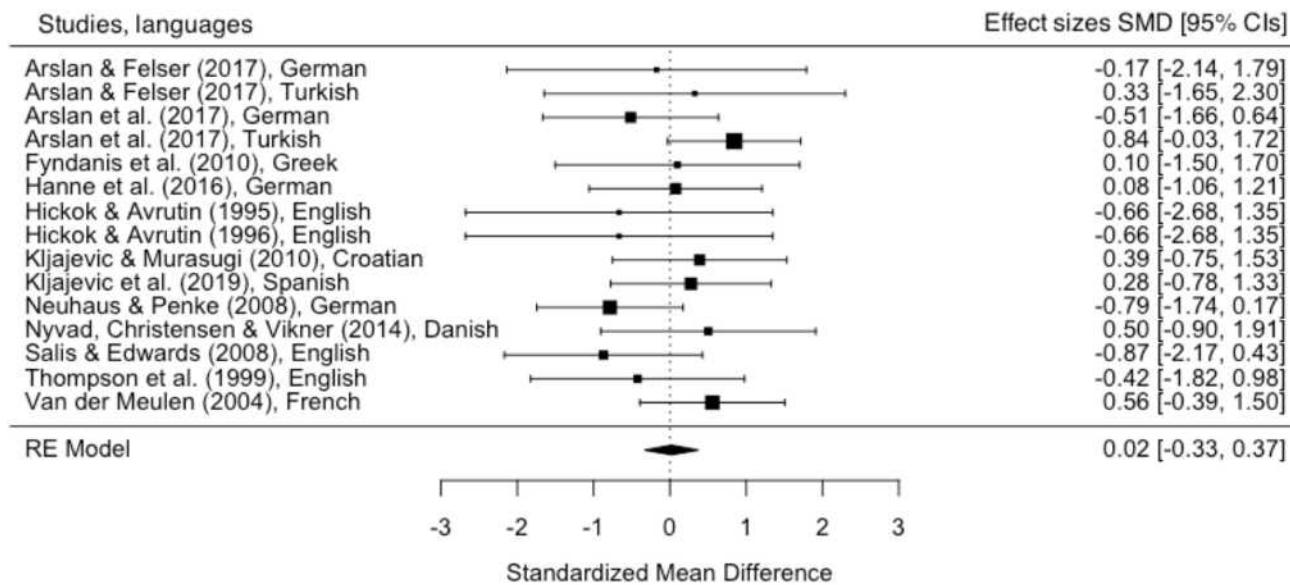
Analysis of individual data - I

Are reflexives better preserved in aphasia than pronouns?



Analysis of individual data - I

Are subject wh-pronouns better preserved than object wh-pronouns?



Analysis of individual data - II

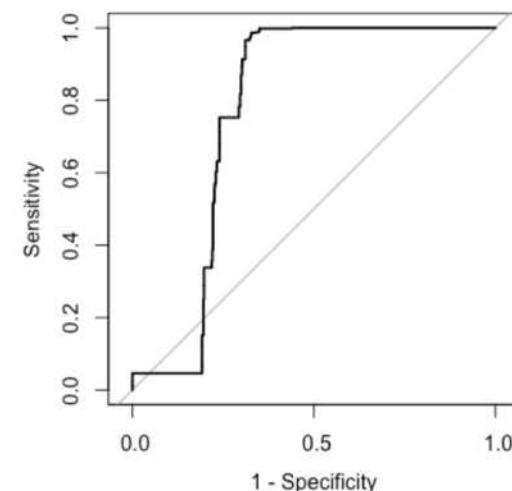
- ▶ A classification approach to determine when pronoun processing impaired in aphasia
 - ▶ studies employed tasks with multiple conditions, different number of items, thus single-measure criteria (e.g. chance) is not appropriate [30]
 - ▶ used a Recipient Operating Characteristic (ROC) curve approach to determine the cut-off value by using the pROC package in R [31]

[30] Ingraham, L. J., & Aiken, C. B. (1996). *Neuropsychology*, 10(1), 120.
[31] Robin, X., et al. (2011). *BMC bioinformatics*, 12(1), 77.



Analysis of individual data - II

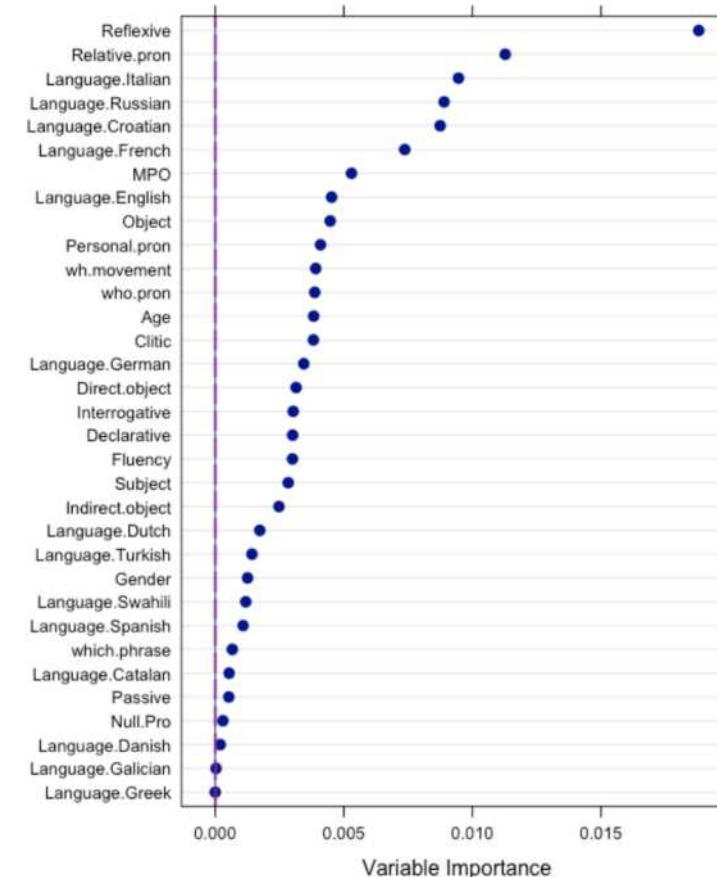
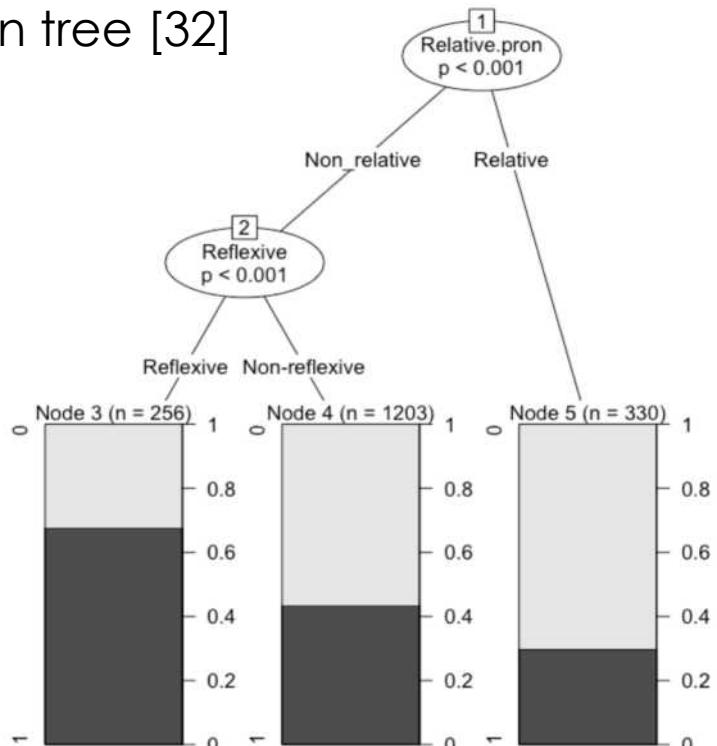
- ▶ when pronoun comprehension impaired in aphasia?
- ▶ Simulated unimpaired group outcomes (N=1793, mean = 93.1%, SD = 4.4)
- ▶ fitted values from a logit regression submitted to Area Under Curve plot
- ▶ AUC = 0.775



Analysis of individual data - II

► when pronoun comprehension impaired in aphasia?

RF based decision tree [32]

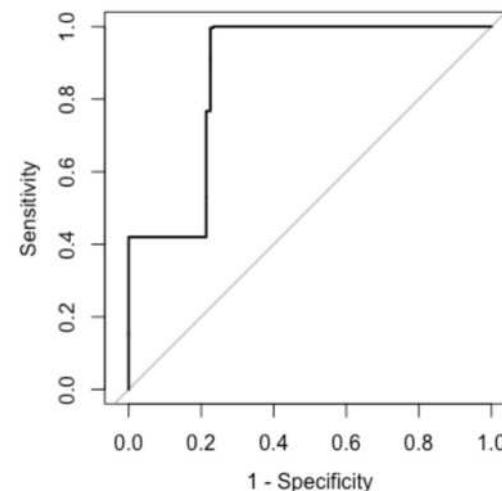


[32] Breiman, L. (2001). Random forests. *Machine learning*, 45(1)

Analysis of individual data - II

- ▶ when pronoun production impaired in aphasia?

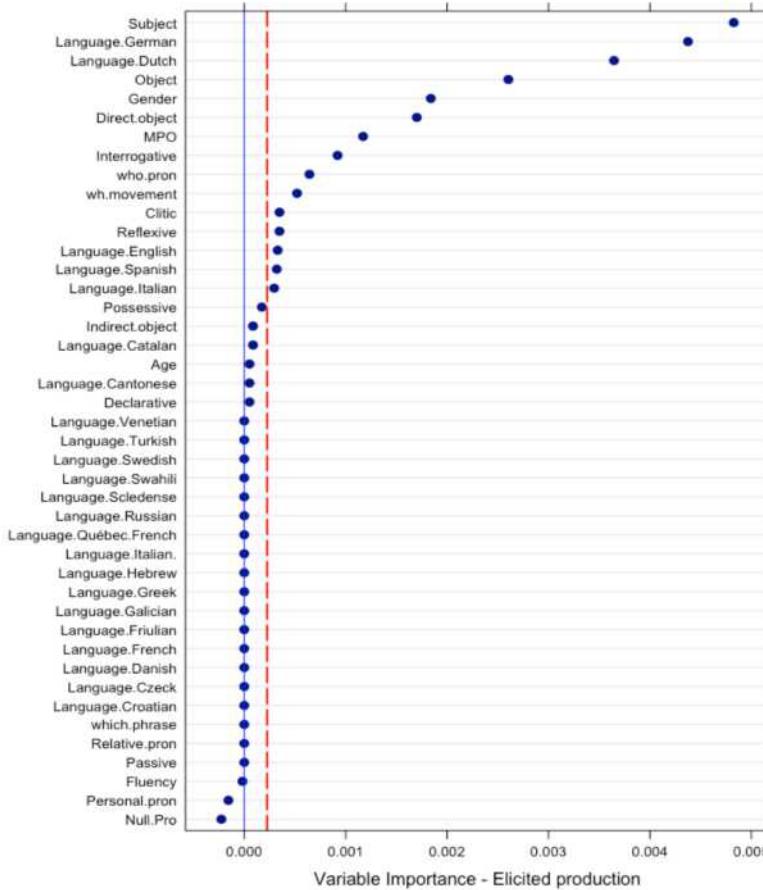
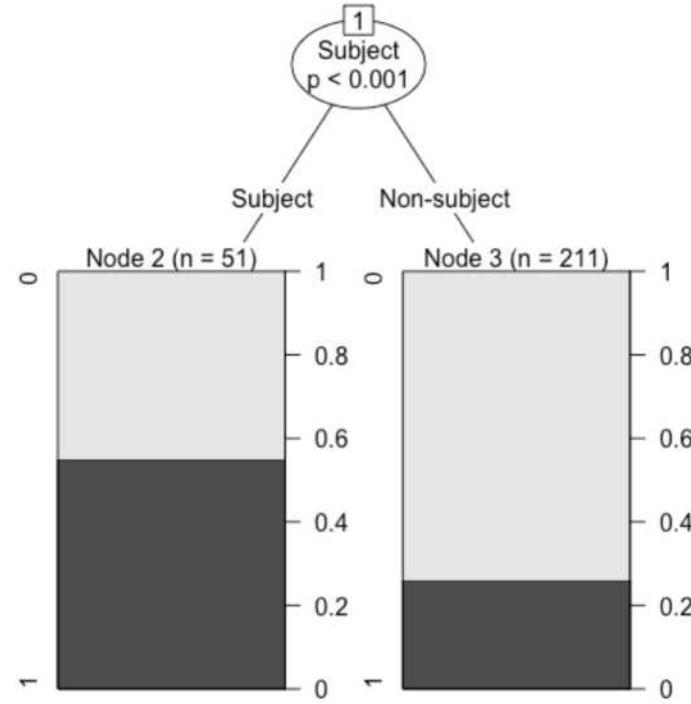
- ▶ Simulated unimpaired group outcomes ($N=262$, mean = 99.1%, SD = 1.9)
- ▶ fitted values from a logit regression submitted to Area Under Curve plot
- ▶ AUC = 0.873



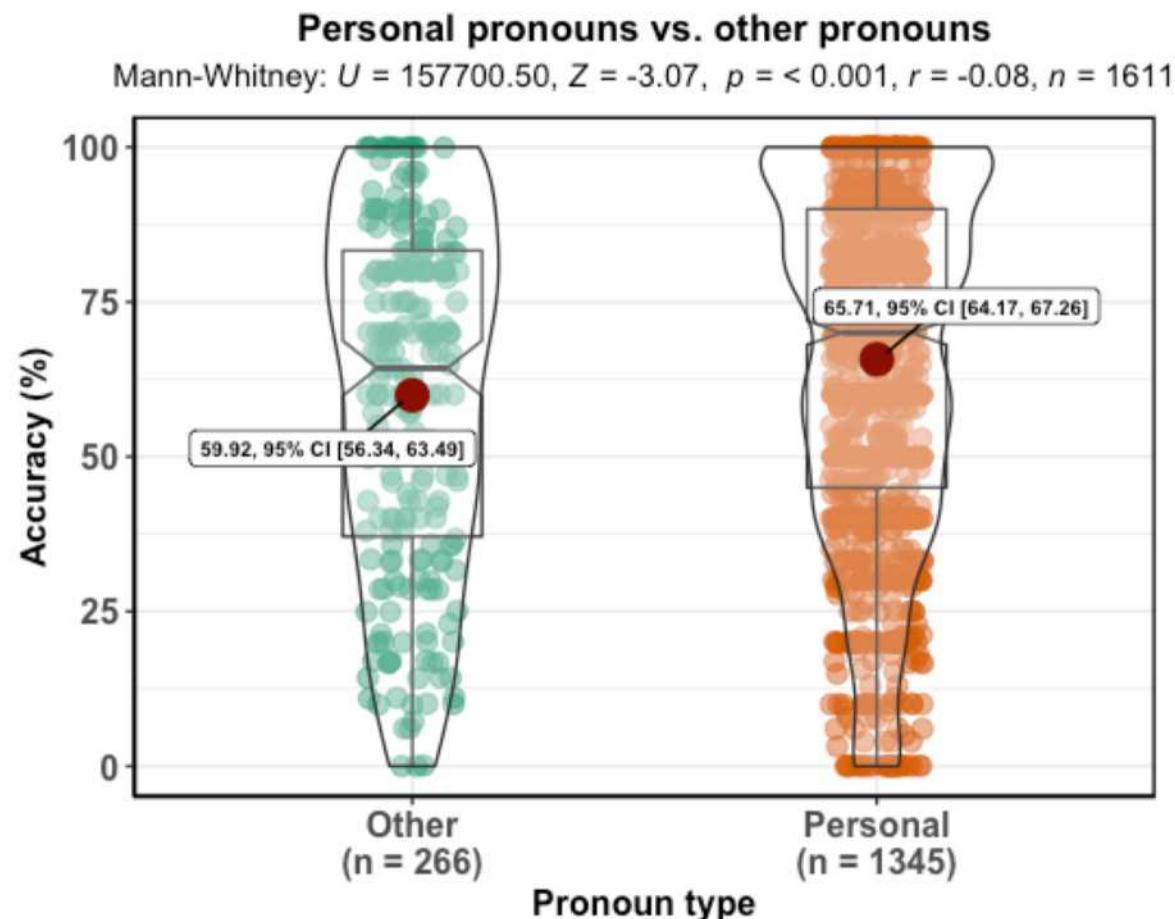
Analysis of individual data - II

► when pronoun production impaired in aphasia?

RF based decision tree [32]



Myths and truths of pronoun processing in aphasia



**Personal pronouns
are better preserved**

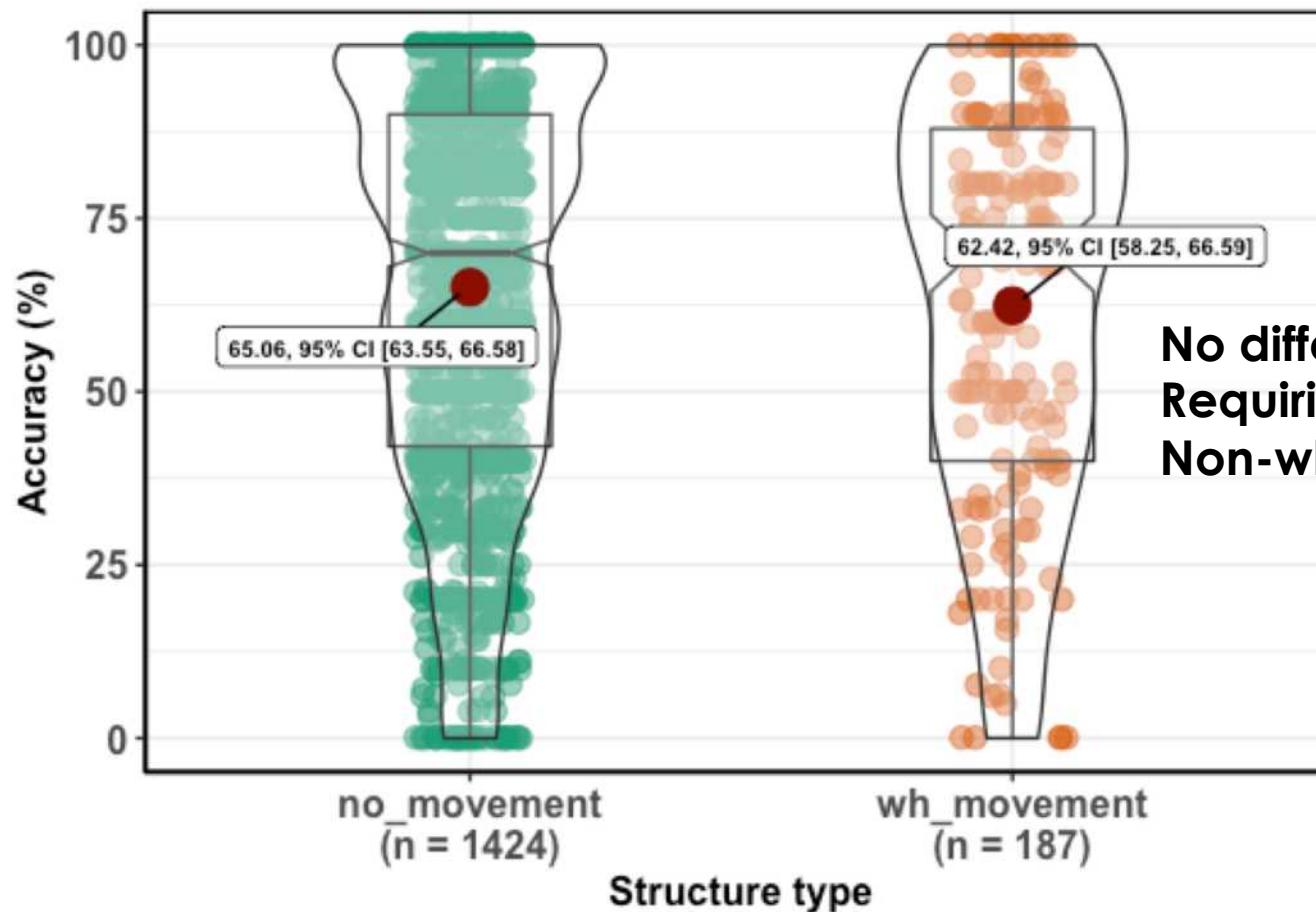


UNIVERSITÉ
CÔTE D'AZUR

Myths and truths of pronoun processing in aphasia

Pronouns in structures requiring wh-movement

Mann-Whitney: $U = 141521.50$, $Z = 1.41$, $p = 0.16$, $r = 0.04$, $n = 1611$

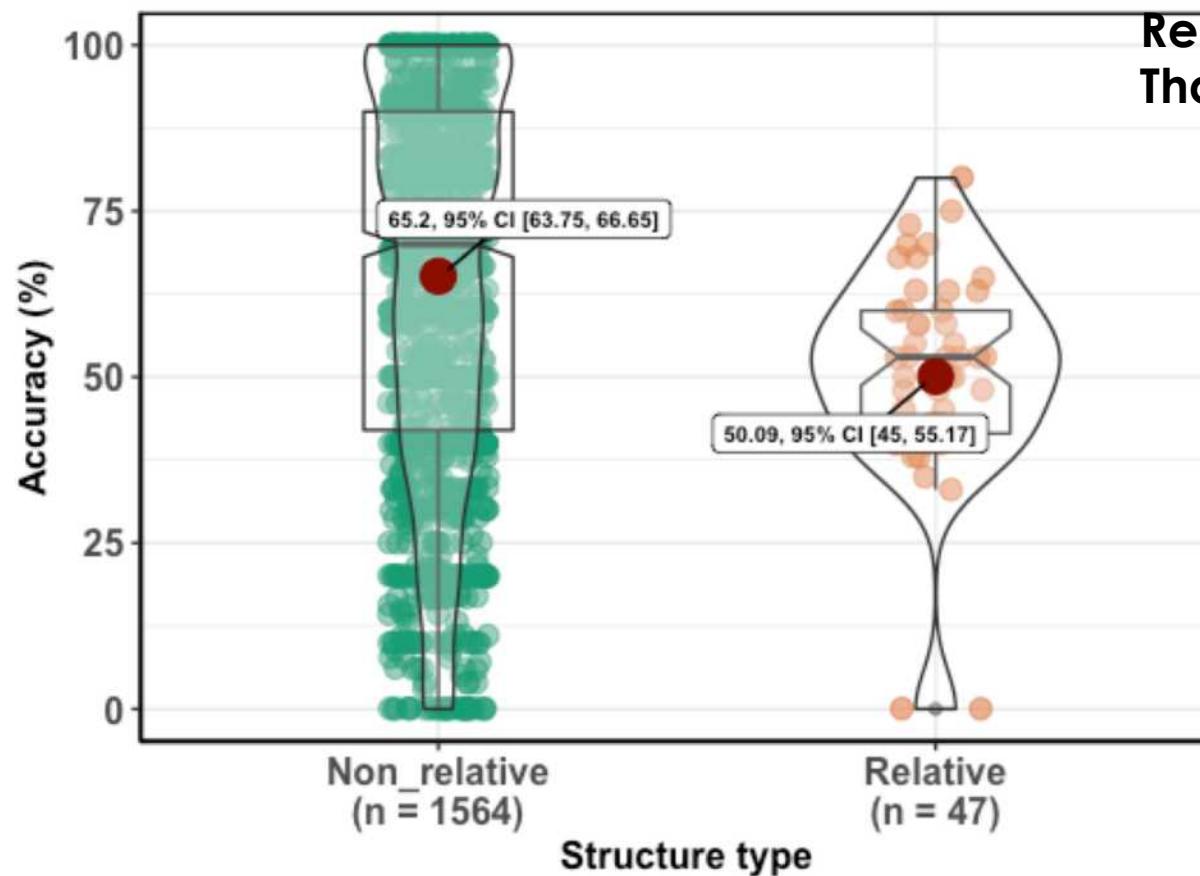


UNIVERSITÉ
CÔTE D'AZUR

Myths and truths of pronoun processing in aphasia

Relative pronouns vs pronouns in non-relatives

Mann-Whitney: $U = 49929.50$, $Z = 4.21$, $p = < 0.001$, $r = 0.10$, $n = 1611$



Relative pronouns are more impaired
Than non-relative pronouns



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package



Dr. Seçkin Arslan



seckin.arslan@rug.nl



[@seckin1984](https://twitter.com/seckin1984)



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

← → ⌂ ⌄ Not Secure | metafor-project.org/doku.php/metafor



[Log In](#)

Search



[Media Manager](#) [Sitemap](#)

The metafor Package A Meta-Analysis Package for R

metafor

Navigation

- [Homepage](#)
- [Package News](#)
- [Package Features](#)
- [Package Update Log](#)
- [To-Do List / Planned Features](#)
- [Download and Installation](#)
- [Documentation and Help](#)
- [Function Diagram](#)
- [Analysis Examples](#)
- [Plots and Figures](#)
- [Tips and Notes](#)
- [Contributors](#)
- [FAQs](#)
- [Links](#)

External Links

- [Wolfgang Viechtbauer](#)
- [The R Project](#)
- [CRAN](#)

The metafor Package: A Meta-Analysis Package for R

The metafor package is a free and open-source add-on for conducting meta-analyses with the statistical software environment **R**. The package consists of a collection of functions that allow the user to calculate various effect size or outcome measures, fit fixed-, random-, and mixed-effects models to such data, carry out moderator and meta-regression analyses, and create various types of meta-analytical plots.

On this website, you can find:

- some [news](#) concerning the package and/or its development,
- a more detailed description of the [package features](#),
- a log of the [package updates](#) that have been made over the years,
- a [to-do list](#) and a description of planned features to be implemented in the future,
- information on how to [download and install](#) the package,
- information on how to obtain [documentation and help](#) with using the package,
- some [analysis examples](#) that illustrate various models, methods, and techniques,
- a little showcase of [plots and figures](#) that can be created with the package,
- some [tips and notes](#) that may be useful when working with the package,



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Effect sizes and meta-analytic screening

- Before running a meta-analytic model, we need to calculate “**effect sizes**”.
- These can be d - or r -family of effect sizes.
- For categorical data, calculate **odds ratio (Odds Ratio, Relative Risk, Logit transformed proportions)**
- Or raw **mean differences (SMD)**



07 – Tutorial with metafor package

Different types of effect sizes with metafor pgc

escalc()

function (= effect size calculator)

```
escalc(measure, ai, bi, ci, di, n1i, n2i, m1i, m2i, sd1i, sd2i, xi, mi, ri, ni,  
       data = NULL, add = 1/2, to = "only0", vtype = "LS", append = FALSE)
```

07 – Tutorial with metafor package

Different types of effect sizes with metafor pgc

Measures from each group

If you have a 2×2 table data !!

		outcome 1	outcome 2	
		ai	bi	n1i
group 1	group 2	ci	di	n2i

Sample size of each group



UNIVERSITÉ
CÔTE D'AZUR

"RR": The log relative risk = the log of $(ai/n1i)/(ci/n2i)$.

"OR": The log odds ratio = the log of $(ai*di)/(bi*ci)$

"RD": The risk difference = $(ai/n1i) - (ci/n2i)$.

07 – Tutorial with metafor package

Different types of effect sizes with metafor pgc

Proportions and transformations (if no 2 x 2 design)

"**PR**": The raw proportion = x_i/n_i .

"**PLO**": The logit transformed proportion = $\log(x_i/(n_i - x_i))$.



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Different types of effect sizes with metafor pgc

Raw and standardized mean differences

"**MD**": The raw mean difference = $m_{1i} - m_{2i}$.

"**SMD**": The standardized mean difference = $(m_{1i} - m_{2i})/s_{pi}$
(Hedges and Olkin 1985).



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Different types of effect sizes with metafor pgc

correlation coefficients

"**COR**": The raw correlation coefficients (r_i)

"**ZCOR**": Fisher's variance stabilizing transformation

$1/2 * \log((1 + r_i)/(1 - r_i))$.



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Let's try out some stuff in R

```
# data("dat.bcg", package = "metafor")
# print(dat.bcg, row.names = FALSE)
```

trial	author	year	tpos	tneg	cpos	cneg	ablat	alloc
1	Aronson	1948	4	119	11	128	44	random
2	Ferguson & Simes	1949	6	300	29	274	55	random
3	Rosenthal et al	1960	3	228	11	209	42	random
4	Hart & Sutherland	1977	62	13536	248	12619	52	random
5	Frimodt-Moller et al	1973	33	5036	47	5761	13	alternate
6	Stein & Aronson	1953	180	1361	372	1079	44	alternate
7	Vandiviere et al	1973	8	2537	10	619	19	random
8	TPT Madras	1980	505	87886	499	87892	13	random
9	Coetzee & Berjak	1968	29	7470	45	7232	27	random
10	Rosenthal et al	1961	17	1699	65	1600	42	systematic
11	Comstock et al	1974	186	50448	141	27197	18	systematic
12	Comstock & Webster	1969	5	2493	3	2338	33	systematic
13	Comstock et al	1976	27	16886	29	17825	33	systematic

N or Tuberculosis patient positive / negative
N of controls positive / negative
Geographical latitude of testing location



07 – Tutorial with metafor package

Let's try out some stuff in R

2 x 2 design

	TB+	TB-
Treated	tpos	tneg
Control	cpos	cneg

```
dat <- escalc(measure = "RR", ai = tpos, bi = tneg, ci = cpos,  
di = cneg, data = dat.bcg, append = TRUE)  
print(dat[,-c(4:7)], row.names = FALSE)
```

Upper and lower bounds of Risk Ratio

trial	author	year	ablat	alloc	yi	vi
1	Aronson	1948	44	random	-0.8893	0.3256
2	Ferguson & Simes	1949	55	random	-1.5854	0.1946
3	Rosenthal et al	1960	42	random	-1.3481	0.4154
4	Hart & Sutherland	1977	52	random	-1.4416	0.0200
5	Frimodt-Møller et al	1973	13	alternate	-0.2175	0.0512
6	Stein & Aronson	1953	44	alternate	-0.7861	0.0069



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package



Arslan, Devers, Martínez-Ferreiro (under revision)



Dr. Seçkin Arslan



seckin.arslan@rug.nl



[@seckin1984](https://twitter.com/seckin1984)



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Study with log odds

A study with number of individuals impaired vs non-impaired

#get data here

```
funnel.data <- read.csv("funnel.data.csv", header = TRUE, sep = ",")
```

	Authors	Modality	Language	ni	xi
1	Abuom et al. (2013)	Comprehension	English	22	21
2	Abuom et al. (2013)	Comprehension	Swahili	22	22
3	Arslan & Felser (2017)	Comprehension	German	8	4
4	Arslan & Felser (2017)	Comprehension	Turkish	8	6
5	Arslan et al. (2017)	Comprehension	German	24	22
6	Arslan et al. (2017)	Comprehension	Turkish	44	33
7	Avrutin, Lubarsky & Greene (1999)	Comprehension	English	16	12
8	Baauw & Cuetos (2003)	Comprehension	Spanish	32	10

ni = number of individuals

xi = number of individuals with
pronoun impairment



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Study with log odds

A study with number of individuals impaired vs non-impaired

```
#calculate logit transformed proportions  
fun.data <- escalc(xi = xi, ni = ni,  
                    data = funnel.data, measure = "PLO", append = TRUE)
```



UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Study with log odds

A study with number of individuals impaired vs non-impaired

Lower and upper bounds
of logit proportion

▲	Authors	Modality	Language	ni	xi	yi	vi
1	Abuom et al. (2013)	Comprehension	English	22	21	3.0445224	1.04761905
2	Abuom et al. (2013)	Comprehension	Swahili	22	22	3.8066625	2.04444444
3	Arslan & Felser (2017)	Comprehension	German	8	4	0.0000000	0.50000000
4	Arslan & Felser (2017)	Comprehension	Turkish	8	6	1.0986123	0.66666667
5	Arslan et al. (2017)	Comprehension	German	24	22	2.3978953	0.54545455
6	Arslan et al. (2017)	Comprehension	Turkish	44	33	1.0986123	0.12121212
7	Avrutin, Lubarsky & Greene (1999)	Comprehension	English	16	12	1.0986123	0.33333333
8	Baauw & Cuetos (2003)	Comprehension	Spanish	32	10	-0.7884574	0.14545455



VERSITÉ
D'AZUR

07 – Tutorial with metafor package

Study with log odds

A study with number of individuals impaired vs non-impaired

```
#random effects models (meta-regression)  
res1 <- rma(yi, vi, data=fun.data)  
summary(res1)
```



UNIVERSITÉ
CÔTE D'AZUR

Random-Effects Model (k = 59; tau^2 estimator: REML)

logLik	deviance	AIC	BIC	AICc
-96.8964	193.7928	197.7928	201.9137	198.0110

tau^2 (estimated amount of total heterogeneity): 0.8878 (SE = 0.2383)
tau (square root of estimated tau^2 value): 0.9422
AI^2 (total heterogeneity / total variability): 85.49%
H^2 (total variability / sampling variability): 6.89

#Test for Heterogeneity:

Q(df = 58) = 290.7948, p-val < .0001

re

Model Results:

sl

estimate	se	zval	pval	ci.lb	ci.ub	
0.5039	0.1521	3.3131	0.0009	0.2058	0.8020	***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1



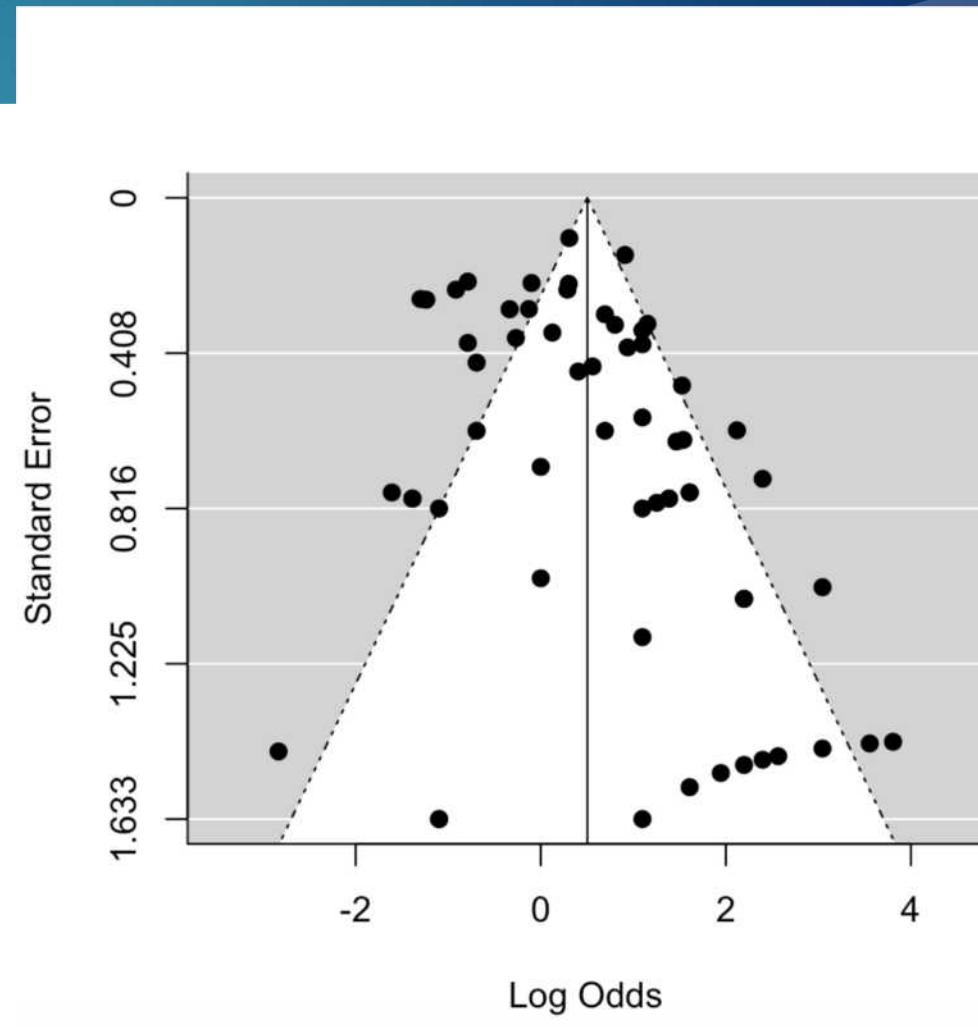
07 – Tutorial with metafor package

Study with log odds

A study with number of individuals impaired

```
# draw funnel plots  
pl1 <- funnel(res1)
```

Heterogeneity was significant, this is normal



07 – Tutorial with metafor package

Study with **standardized mean difference**

A study with whether pronoun vs reflexive impaired more

```
#read data
```

```
reflex_data <- read.csv("reflex_training.csv",  
header = TRUE, sep = ",")
```

	Authors	Fluency	Ref_ACC	Pro_ACC
1	Baauw & Cuetos (2003)	0	82.29063	67.70812
2	Bos et al. (2014)	0	96.25000	98.00000
3	Bos et al. (2014)	1	95.75000	91.50000
4	Caplan et al. (2015)	0	54.18033	53.36066
5	Choy & Thompson (2010)	0	63.75000	65.00000
6	Edwards & Varlokosta (2007)	0	48.95000	50.93333
7	Gavarró (2008)	0	100.00000	82.50000
8	Grodzinsky et al. (1993)	0	84.37250	68.22688
9	Grodzinsky et al. (1993)	1	89.58125	70.83000
10	Hickok & Avrutin (1995)	0	91.50000	50.00000
11	Martinez-Ferreiro (2010)	0	84.31500	64.00250
12	Ruigendijk, Vasic & Avrutin (2006)	0	97.66667	81.57143
13	Sanchez-Alonso et al. (2011)	0	75.09091	29.72727

07 – Tutorial with metafor package

Study with **standardized mean difference**

A study with whether pronoun vs reflexive impaired more

```
# calculate effect sizes with escalc function  
tfun.data <- escalc(m1i = Ref_ACC, m2i = Pro_ACC,  
sd1i= Ref_sd, sd2i = Pro_sd, n1i = Ref_n, n2i = Pro_n,  
data = reflex_data, measure = "SMD", append = TRUE)
```



07 – Tutorial with metafor package

Study with **standardized mean differences**

A study with whether pronoun

```
# calculate effect sizes with  $\epsilon^2$ 
tfun.data <- escalc(m1i = Ref_n,
sd1i = Ref_sd, sd2i = Pro_sd, n1i = Pro_n)
```

data = reflex_data, measure = "SMD")

Authors.2	Fluency.2	Ref_n	Pro_n	yi	vi
Baauw & Cuetos (2003)	0	4	4	0.42964859	0.51153737
Bos et al. (2014)	0	10	10	-0.31777756	0.20252456
Bos et al. (2014)	1	10	10	0.39712541	0.20394271
Caplan et al. (2015)	0	61	61	0.02036193	0.03278858
Choy & Thompson (2010)	0	8	8	-0.07001445	0.25015319
Edwards & Varlokostra (2007)	0	10	10	-0.06487655	0.20010522
Gavarró (2008)	0	2	2	1.97466354	1.48741201
Grodzinsky et al. (1993)	0	8	8	0.85958506	0.27309020
Grodzinsky et al. (1993)	1	4	4	0.68647524	0.52945302
Hickok & Avrutin (1995)	0	2	2	2.00587980	1.50294422
Martinez-Ferreiro (2010)	0	6	6	0.68133037	0.35267546
Ruigendijk, Vasic & Avrutin (2006)	0	3	7	0.93104273	0.51953250
Sanchez-Alonso et al. (2011)	0	11	11	1.25940944	0.21786618

07 – Tutorial with metafor package

Study with **standardized mean difference**

A study with whether pronoun vs reflexive impaired more

```
#random effects model  
res <- rma(yi, vi, data=tfun.data)  
summary(res)
```



UNIVERSITÉ
CÔTE D'AZUR

Random-Effects Model (k = 13; tau^2 estimator: REML)

logLik	deviance	AIC	BIC	AICC
-11.9518	23.9036	27.9036	28.8734	29.2369

S tau^2 (estimated amount of total heterogeneity): 0.0930 (SE = 0.1336)

A tau (square root of estimated tau^2 value): 0.3049

I^2 (total heterogeneity / total variability): 28.57%

H^2 (total variability / sampling variability): 1.40

Test for Heterogeneity:

Q(df = 12) = 16.1291, p-val = 0.1854

re

Model Results:

estimate	se	zval	pval	ci.lb	ci.ub
0.3892	0.1681	2.3147	0.0206	0.0596	0.7187 *

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1



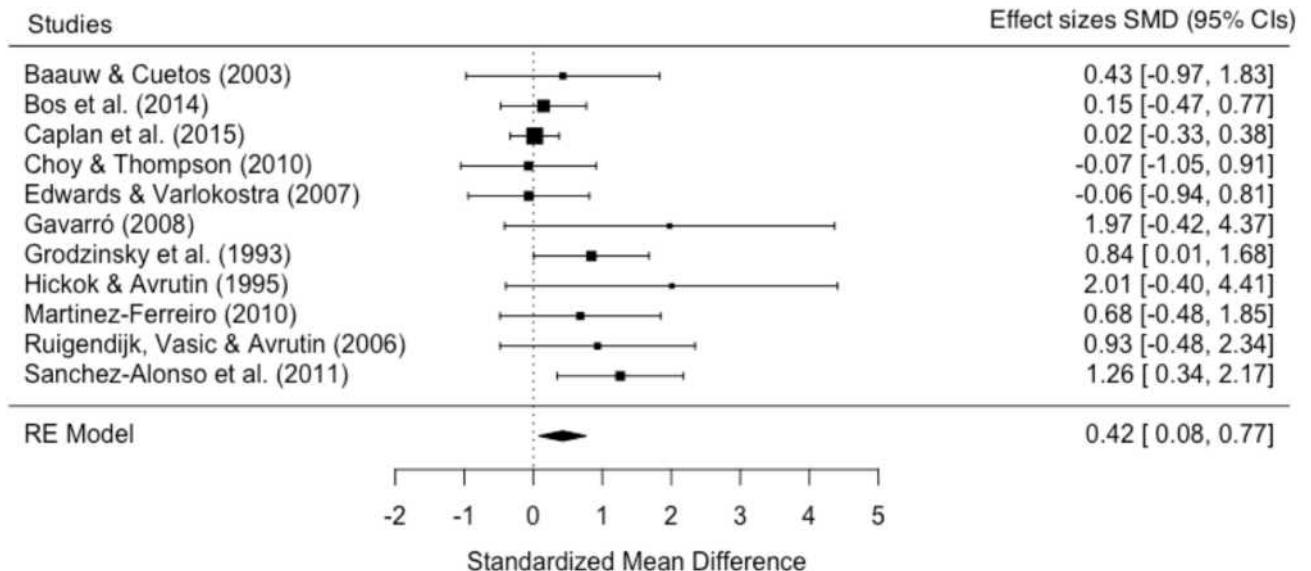
UNIVERSITÉ
CÔTE D'AZUR

07 – Tutorial with metafor package

Study with **standardized mean difference**

A study with whether pronoun vs reflexive impaired more

```
#forest plot  
forest(res, slab =  
paste(tfun.data$Authors, sep = ", "))
```



07 – Systematic Review



Questions???



Dr. Seçkin Arslan



seckin.arslan@rug.nl



[@seckin1984](https://twitter.com/seckin1984)



UNIVERSITÉ
CÔTE D'AZUR