

# Using evidence synthesis in linguistics and computational linguistics in evidence synthesis



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67 StuTS Bayreuth 22 May 2020



"The latest research shows that we really should do something with all this research."

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# Evidence synthesis in a nutshell

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## Key aspects of scientific evidence synthesis

- originates in health sciences (evidence-based medicine)
- adopted for ecology and conservation research, social and education research...and empirical language research!
- reporting standards, procedures and software solutions are developed to ensure high standards of evidence synthesis (standardized methodologies such as the PRISMA statement)

Cf. Chandler et al. (2019); Haddaway and Bilotta (2016); Gough et al. (2017); Moher et al. (2009)

# Evidence synthesis in a nutshell

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## Key reasons to undertake evidence synthesis

- overcome limitations of single studies by:
- provide robust evidence to inform decision-making („what works?“; curriculum recommendations, effectiveness of interventions ...)
- build theories on robust evidence instead of single papers with limited external validity
- demonstrate knowledge gaps to direct future research

Cf. Chandler et al. (2019); Haddaway and Bilotta (2016); Gough et al. (2017); Moher et al. (2009)

# Systematic Reviews and Meta-Analyses

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## **Systematic reviews minimize risk of bias by:**

- carefully reporting all steps of the review for clarity
- identifying all relevant empirical research on a well-defined research question using a refined search strategy
- assessing the quality of the evidence using pre-defined criteria (e.g. for validity)
- synthesizing evidence from multiple studies (through non-quantitative synthesis or meta-analysis)

## **Meta-analysis is an analysis of analysis**

- Statistical methods are used to aggregate results from multiple studies

Cf. Chandler et al. (2019); Weiß and Wagner (2019); Gough et al. (2017), Cooper et al. (2009)

# Some examples from linguistic research

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## **Theory-building in phonetics:**

Using meta-analysis for evidence synthesis: The case of incomplete neutralization in German (Nicenboim, Roettger & Vasishth 2018)

## **Multilingualism research with applications in Education Practice and Policy:**

A systematic review of the impact of multiple language teaching, prior language experience and acquisition order on students' language proficiency in primary and secondary school (Dyssegaard et al. 2015)

## **Research in bilingualism with clinical applications:**

Bilingualism Is Associated with a Delayed Onset of Dementia but Not with a Lower Risk of Developing it: a Systematic Review with Meta-Analyses (Brini et al. 2020)

# Methodological problems need to be addressed

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**Idea:** Evidence synthesis aims to produce the most recent and robust evidence to drive theory, inform policy and recommend interventions.

**Problem:** Methodological challenges negatively impact the potential of current evidence syntheses.

- Low quality of systematic reviews and meta-analyses → unexplained conflicting evidence
- Redundancy due to duplicate work
- Lack of high-quality primary studies
- High cost for updating reviews when new evidence is published

Cf. Berthele (2019); Westgate and Lindenmayer (2017), Norris and Lourdes (2007)

# Two approaches for better evidence synthesis

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**The challenge:** make evidence synthesis more efficient, agile, transparent, rigorous and accessible

**The technical approach:** automation of labor-intensive tasks and reduction of bias, e.g. through implementing text mining and machine learning.

**The holistic approach:** imagining a new ecosystem for evidence synthesis, including technical solutions for facilitation of collaboration and interoperability

# How computational linguistics improves evidence synthesis

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**Context and complication:** scientific literature as a corpus

**Complication:** identification of relevant material (documents, concepts)

**Consequence:** Software such as The *litsearchr* R package (Grames et al. 2019)

- a quick, objective and reproducible method to automate search term selection
- identifies search terms for systematic reviews using text mining and keyword co-occurrence networks for conducting searches in electronic databases..
- Reduces bias by extracting keywords from a large dataset of highly relevant documents

**Outlook:** Using NLP to understand and map the semantic complexity of scientific literature, modeling context-dependency and temporal shift of word meanings etc.

Cf.. Beller et al. (2018); Westgate and Lindenmayer (2017)



# How open synthesis communities improve evidence synthesis

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## **Context:**

“we should reconsider the way we synthesize evidence” (Nakagawa et al. p. 1).

## **Complication:**

Empiricists and synthesists do not communicate, leading to poor quality and redundancy

## **Consequence:**

A new ecosystem of evidence synthesis where synthesis is recognized as the end goal of all empirical research. This ecosystem facilitates openness and

Cf. Nakagawa et al. (2020)

# Imagining an ecosystem for evidence synthesis

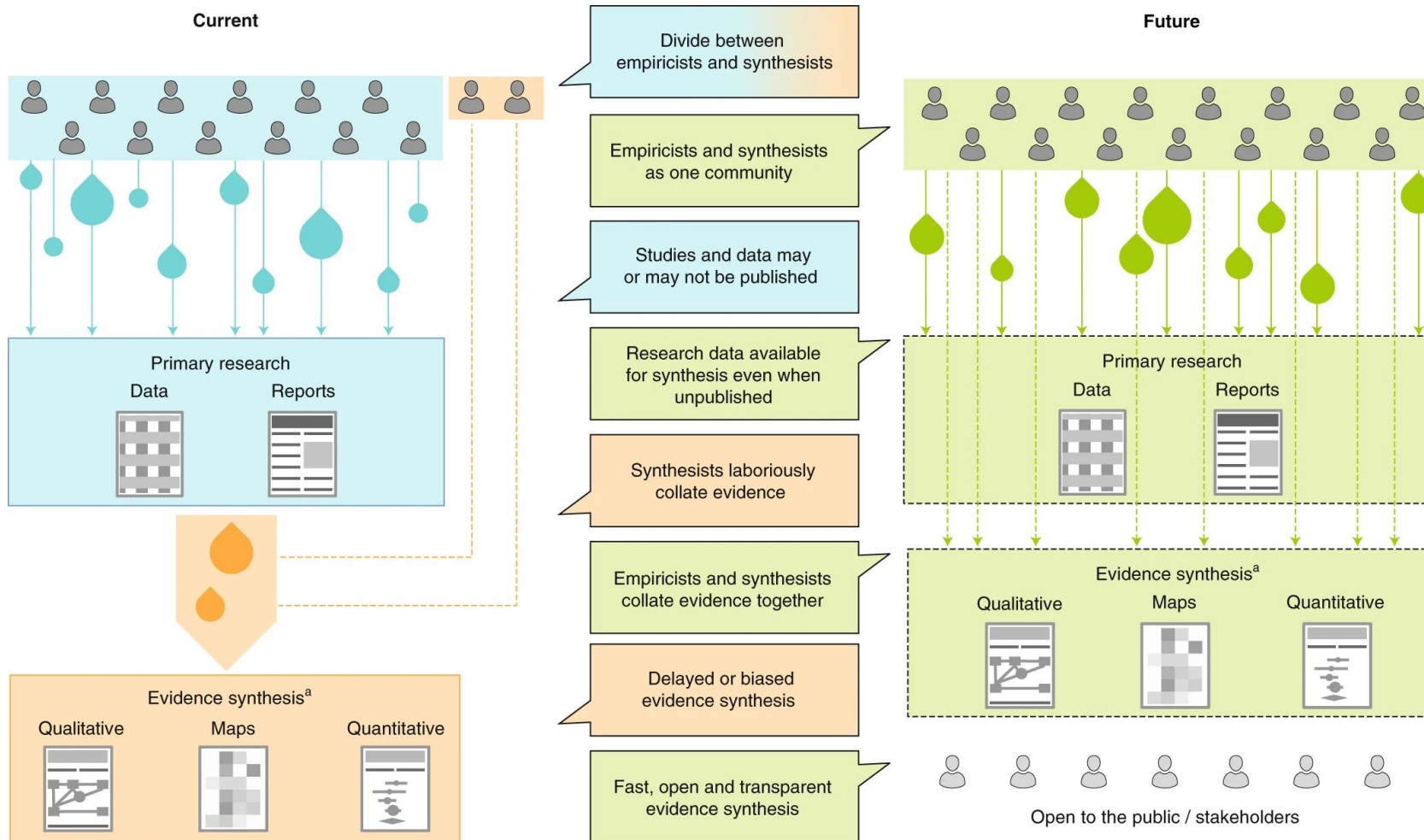


Fig. 1 from Nakagawa et al. (2020)

# Summary

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- **Systematic reviews and meta-analysis produce robust evidence** to potentially inform decision-making in research and practice
- **Current challenges for evidence synthesis:** high costs, redundancy, lack of or missing access to high-quality primary research
- **Solutions:** a new ecosystem of evidence synthesis promotes open synthesis communities and technical solutions to tackle current challenges

# Questions – Discussion – Feedback

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Please use the *raise your hand* feature to indicate you want to ask a question



Don't forget to unmute when it's your turn to ask a question



Don't forget to mute when you are done asking your question



Didn't get to ask your question? Want to give feedback?  
Feel free to get in touch via  or  @LeonieTwente

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