Bias in Epidemiological Studies: the big picture

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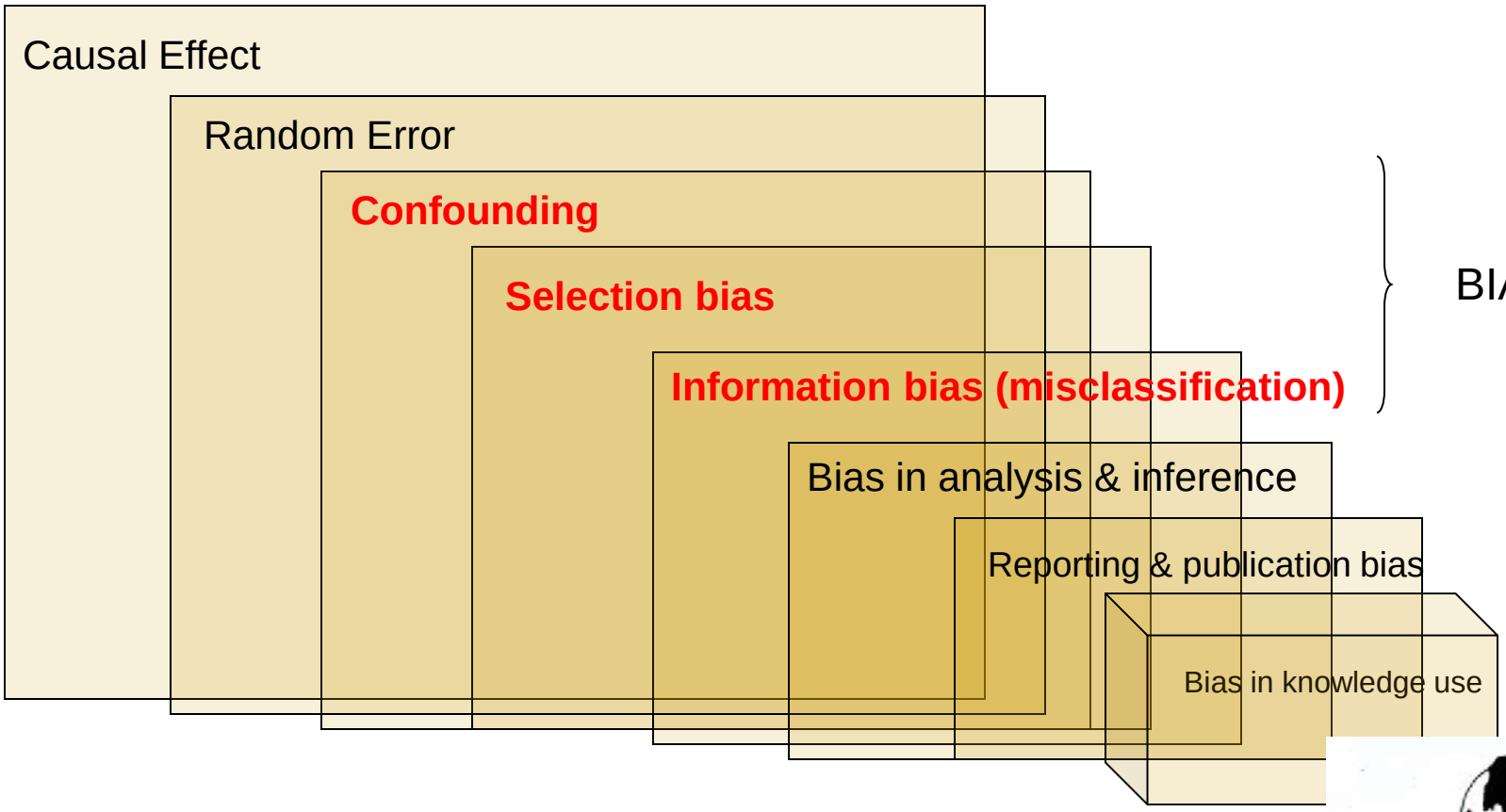
The long road to causal inference (the “big picture”)

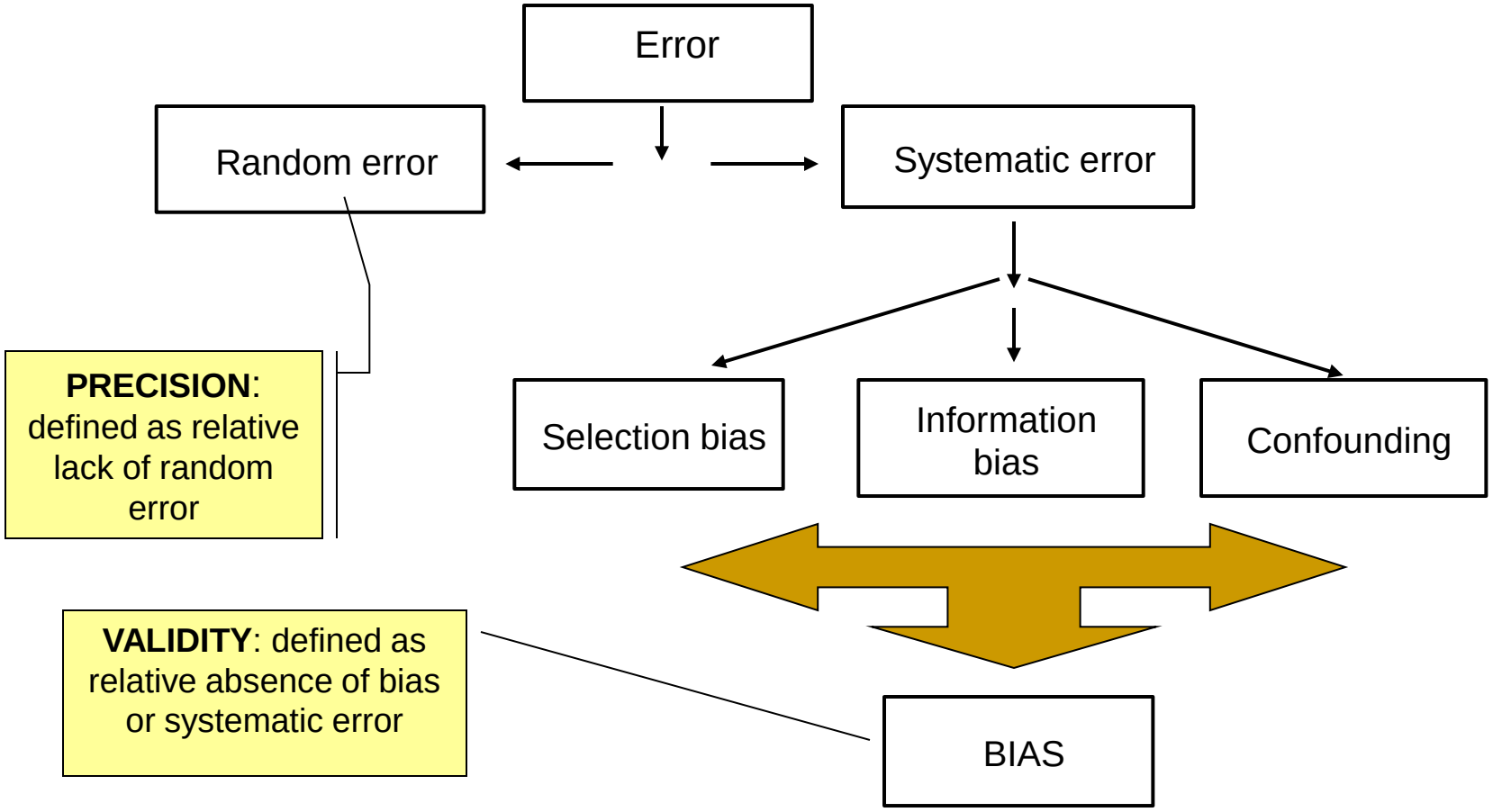


RR_{causal} “truth” → $RR_{association}$

the long road to causal inference…

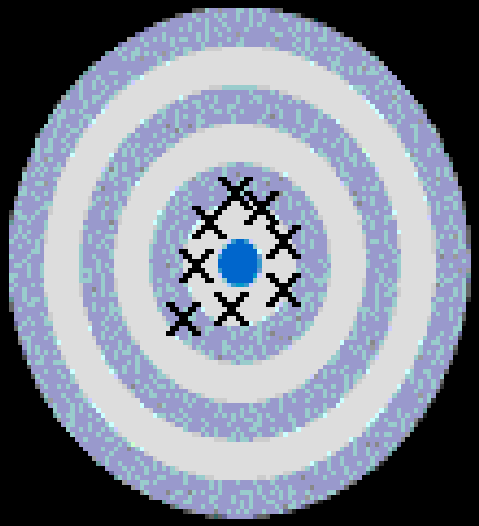
Adapted from: Maclure, M, Schneeweis S. Epidemiology 2001;12:114-122.

Errors in epidemiological inference

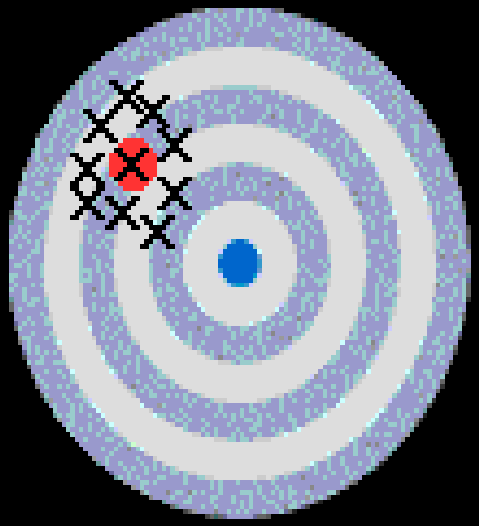


"Bias is any process at any stage of inference which tends to produce results or conclusions that differ systematically from the truth" – Sackett (1979)

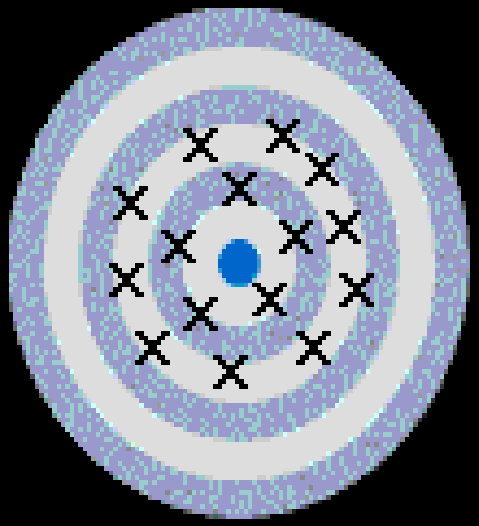
"Bias is systematic deviation of results or inferences from truth." [Porta, 2008]



More Precision
Valid



More Precision
Not Valid



Less Precision
Valid

Precision: Statistical Inference

Validity: Methodological Imperfections

Quantitative definition of bias

- Effect estimate in the source population (parameter of interest) = θ
- Effect estimate in the actual study sample (effect estimate from study) = $\hat{\theta}$

$\hat{\theta}$ is a biased estimate of θ if $\hat{\theta} - \theta \neq 0$

Direction of bias

- ***Positive bias*** – observed effect is higher than the true value (causal effect)
- ***Negative bias*** – observed effect is lower than the true value (causal effect)

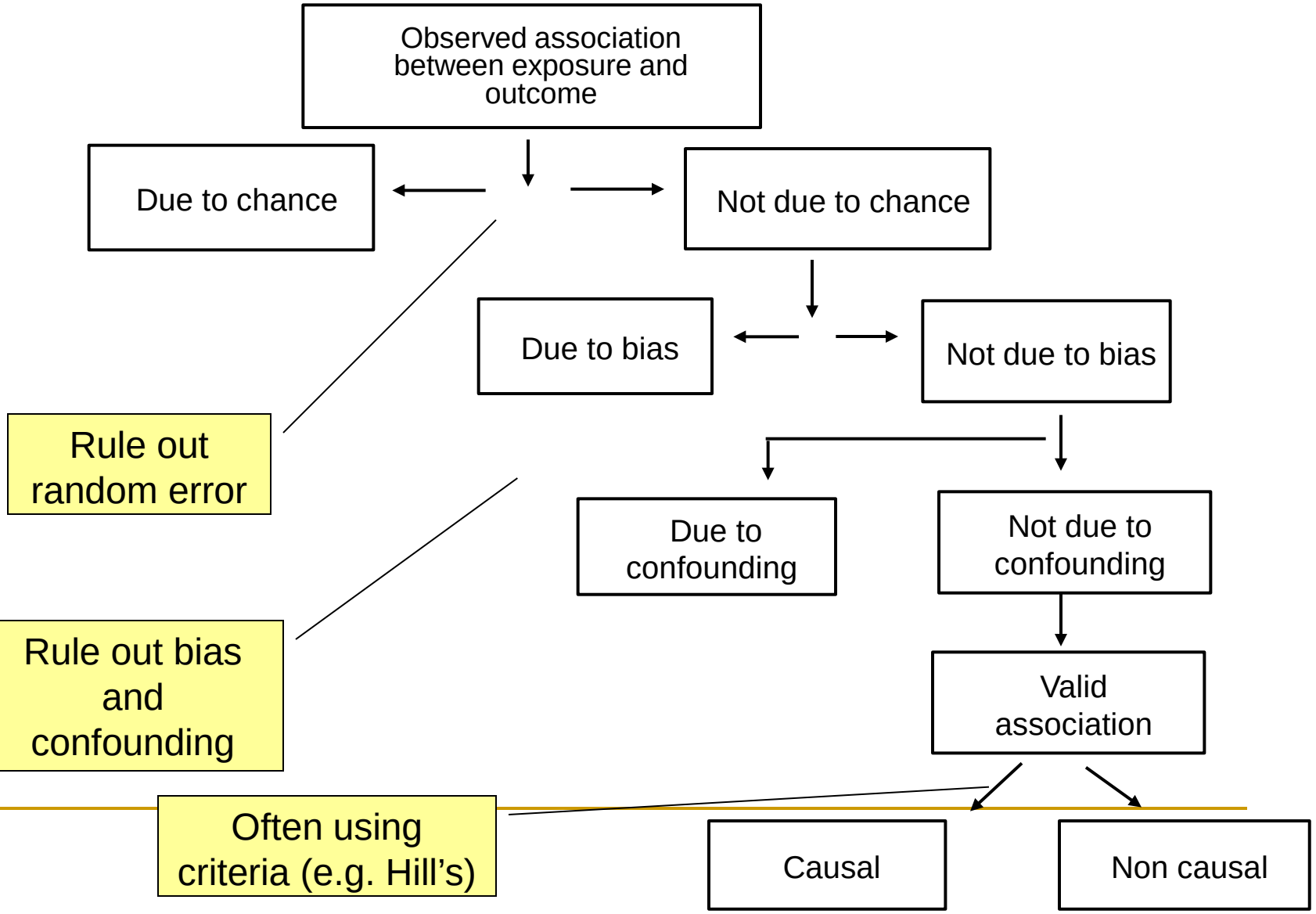
A better approach would be:

- ***Bias towards the null*** – observed value is closer to 1.0 than is the true value (causal effect)*

- ***Bias away from the null*** – observed value is farther from 1.0 than is the true value (causal effect)*

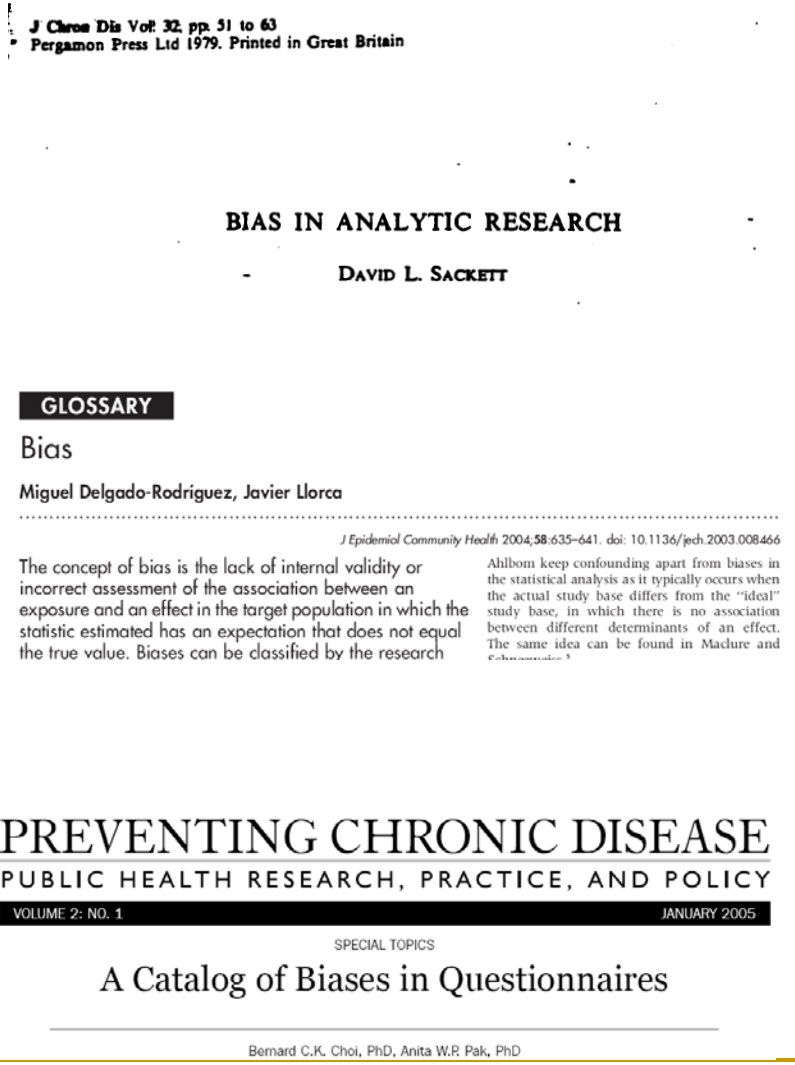
*Note: 1 is the null value for ratio measures (e.g. OR, RR), but not for risk difference Measures (where null value is 0)

A Skeptic's Algorithm for Associations



Some “catalogs” of biases

- Sackett DL. Bias in analytic research. J Chronic Dis 1979;32:51-63.
- Delgado-Rodriguez et al. Bias. J Epidemiol Comm Health 2004;58:635-41.
- Choi BCK et al. A catalog of biases in questionnaires. Preventing Chronic Disease Jan 2005;2(1):1-13



J Chron Dis Vol. 32, pp. 51 to 63
Pergamon Press Ltd 1979. Printed in Great Britain

BIAS IN ANALYTIC RESEARCH

DAVID L. SACKETT

GLOSSARY

Bias

Miguel Delgado-Rodríguez, Javier Llorca

J Epidemiol Community Health 2004;58:635–641. doi: 10.1136/jech.2003.008466

The concept of bias is the lack of internal validity or incorrect assessment of the association between an exposure and an effect in the target population in which the statistic estimated has an expectation that does not equal the true value. Biases can be classified by the research

Ahlbom keep confounding apart from biases in the statistical analysis as it typically occurs when the actual study base differs from the "ideal" study base, in which there is no association between different determinants of an effect. The same idea can be found in Maclure and

PREVENTING CHRONIC DISEASE

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SPECIAL TOPICS

A Catalog of Biases in Questionnaires

Bernard C.K. Choi, PhD, Anita W.P. Pak, PhD

Bias analysis (sensitivity analysis)

The Stata Journal (2008)
8, Number 1, pp. 29–48

A tool for deterministic and probabilistic sensitivity analysis of epidemiologic studies

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Applying Quantitative Bias Analysis to Epidemiologic Data
Springer, 2009
Lash, Timothy L., **Fox**, Matthew P., **Fink**, Aliza K.

This year, for the first time, in EPIB-601:

Compiled by

Madhukar Pai, MD, PhD

Jay S Kaufman, PhD

Real life case studies of how things went wrong and what we can learn from them!

Many will be introduced in EPIB-601 and discussed at a higher level in EPIB-603

Readings

- Rothman:
  - Chapter 5: Biases in Study Design
- Gordis:
  - Chapter 14: From Association to Causation
  - Chapter 15: More on Causal Inferences: Bias, Confounding, and Interaction
- Articles:
  - Delgado-Rodriguez et al. Bias. J Epi Comm Health 2004.

AVERAGE TIME SPENT COMPOSING ONE E-MAIL