Analysis of change from baseline AND/OR ANCOVA?

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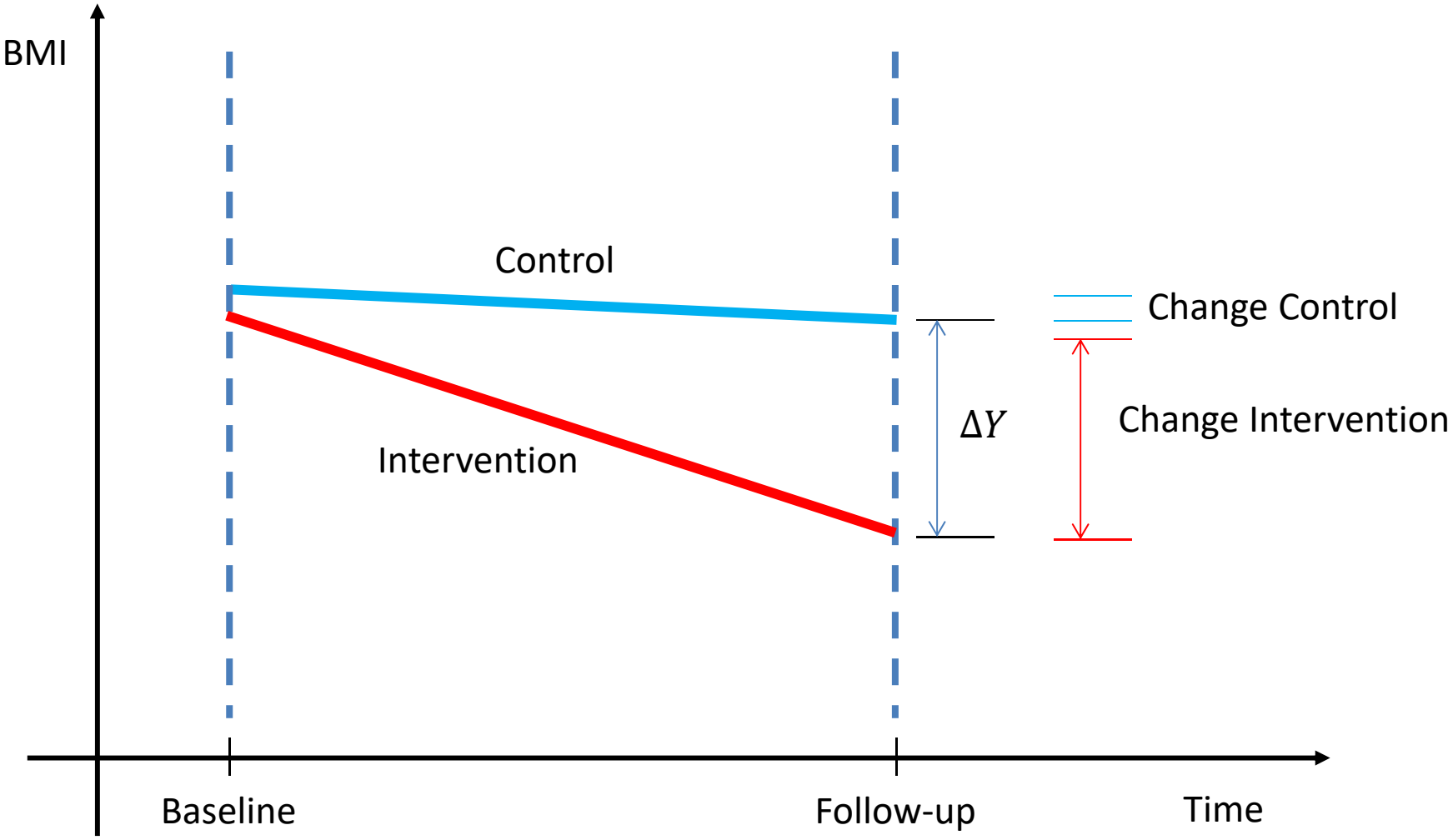
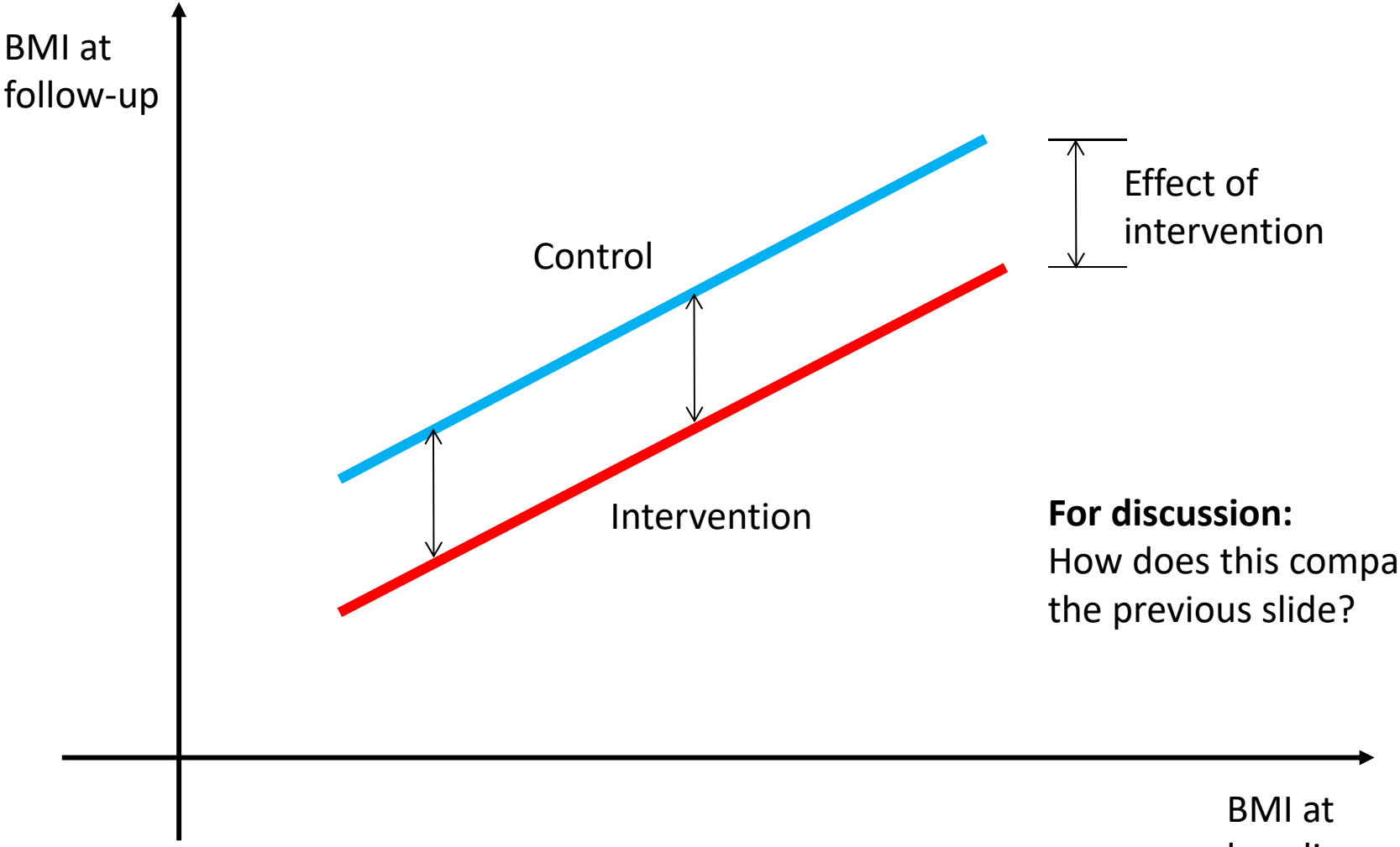
Overview

- The problem
  - Study design
  - Types of analysis (unadjusted, SACS, ANCOVA)
- Example of analysis
  - Baseline value affects group membership *causally*
  - Group membership is *on average* unaffected by baseline value
- Lord's paradox
- Recommendations
- Discussion

Study design (SACS)



Study design (ANCOVA)

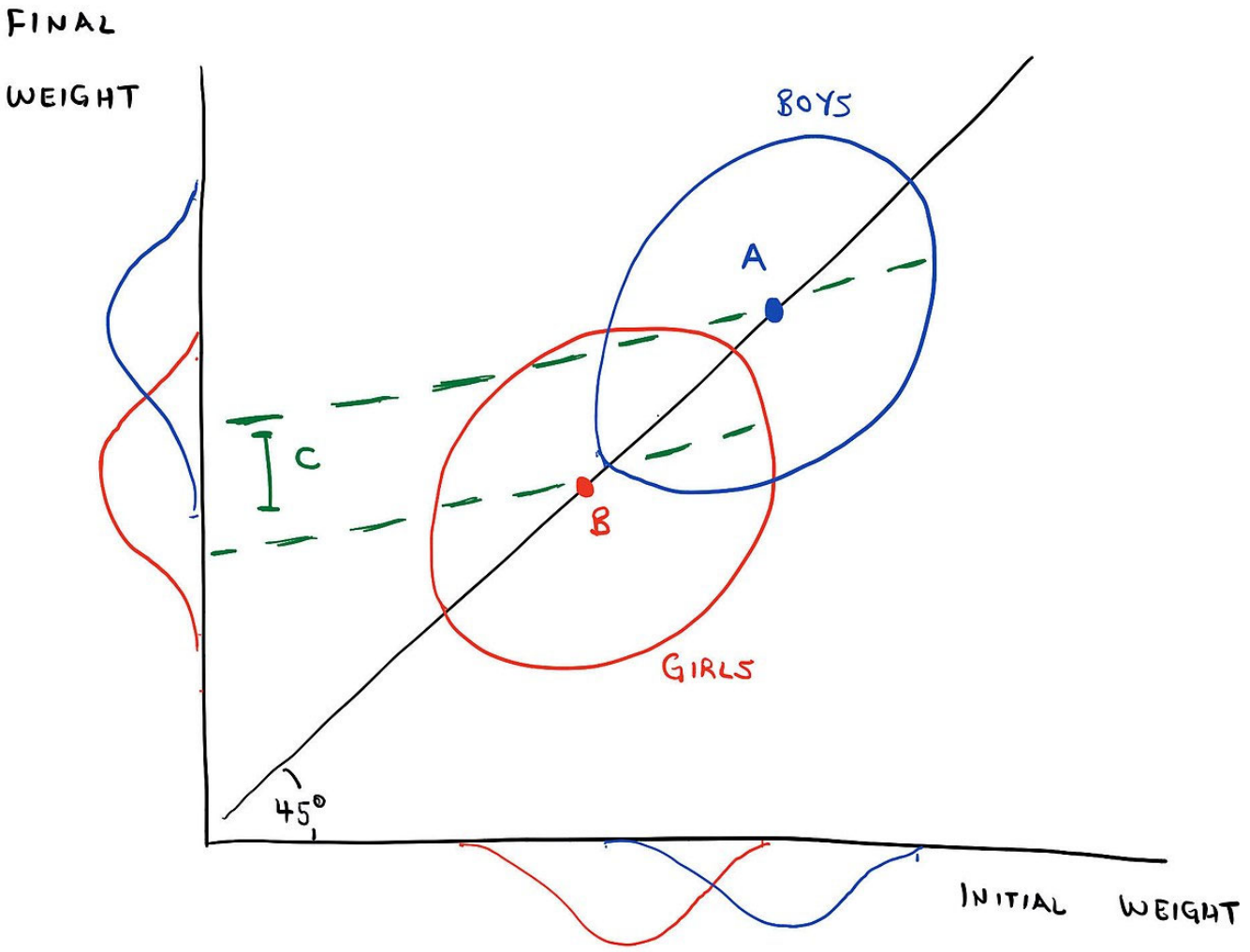


For discussion:
How does this compare to the previous slide?

Examples of analyses

- (see do-file)

Lord's paradox



Interpretations due to analysis strategy

- Statistician 1:
  - "[A]s far as these data are concerned, there is no evidence of any interesting effect of diet (or of anything else) on student weights. In particular, there is no evidence of any differential effect on the two sexes, since neither group shows any systematic change."
- Statistician 2:
  - ...finds that the intercept differs for boys vs girls, and concludes that the new diet had a larger impact for males.

(taken from: https://en.wikipedia.org/wiki/Lord%27s_paradox)

Resolving the paradox(?)

“Cox and McCullagh interpret the problem by constructing a model of what could have happened had the students not dined in the dining hall, where they assume that a student's weight would have stayed constant. They conclude that in fact the first statistician was right ***when asking about group differences***, while the second was right ***when asking about the effect on an individual***.”
(my emphasis)

Resolving the paradox II (?)

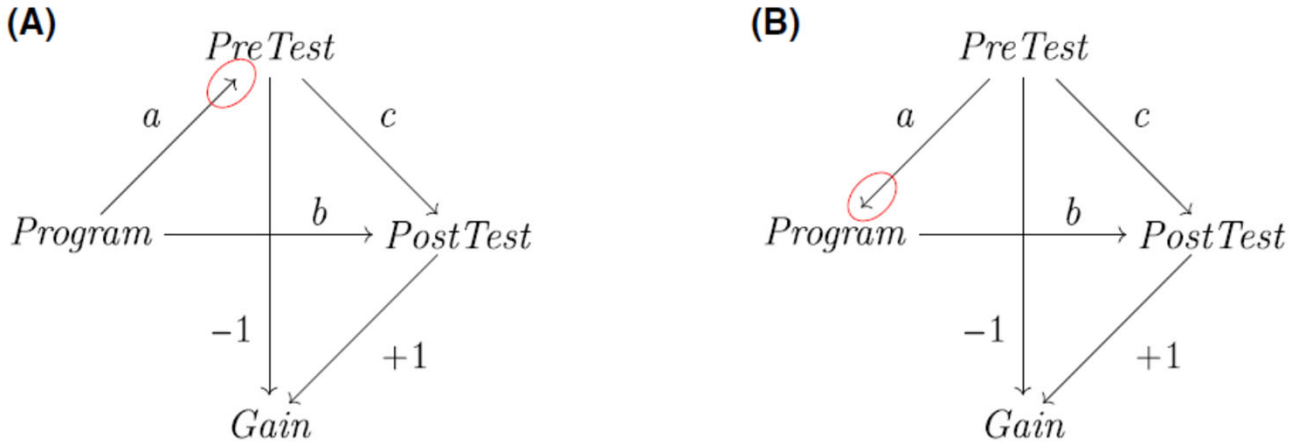


Figure 2. Panel (A) shows the graph based on Lord's original formulation, with *Program* influencing PreTest and PostTest. In Panel (B), the direction of causality is now from PreTest to *Program*. These are based on figures 2b and 5 of Pearl (2016) and table 1 of Rubin (1977).

General advice

- **“Fuzzy conclusion”**

In Panel B, group membership is influenced by the initial scores. Holland and Rubin (1983, pp. 21–22) describe this situation in §A.4 of their appendix and show (assuming linearity and parallel slopes for the groups) that the ANCOVA approach yields appropriate estimates. Pearl (2016) uses graphical models and reaches a similar conclusion: in Panel A, both approaches can be correct depending on the research question and assumptions, but for Panel B, ‘one [statistician] was right (ANCOVA) and one [statistician] was wrong’. Wright (2006) reached similar conclusions, but using simulation methods. When the group is not influenced by the covariate, and the assumptions for gain score model in Holland and Rubin (1983) hold, the gain score approach provides unbiased estimates and ANCOVA does not. The converse is true when the covariate influences group membership.

- **Senn paraphrased**
  - Except for pathological situations, ANCOVA is unbiased and more precise

Thanks for your attention – questions welcome!

(Djursland, July 2015 – H Støvring)