

I-3.

Austin Bradford Hill: The Environment and Disease:  
Association or Causation?  
Proceedings of the Royal Society of Medicine 1965; 58:295-300.

Hill's "The Environment and Disease: Association or Causation" may be a good example of an article that has been read in quotations and paraphrases more often than in its original form. In it, Hill offered a list of nine aspects of an empirical association to consider when deciding whether an association is causal. This was not the first list of "causal criteria" to be offered, but it was perhaps the most popular. It is unfortunate that in the ensuing decades, this list or similar ones have been presented in textbooks as "criteria" for inferring causality of associations, often in such a manner as to imply that all the conditions are necessary. A careful reading of Hill shows that he did not intend to offer a list of necessary conditions; on the contrary, on page 299 he warned against laying down "hard and fast rules of evidence that must be obeyed before we accept cause and effect." As noted later [Rothman, 1982], Hill's only real mistake was to say that *none* of his nine aspects could be considered necessary if the association were indeed causal; in fact, temporality (No. 4) is obviously necessary, as cause must precede effect.

Perhaps the most neglected portion of the article (also on page 299) is his comment on the misuse of significance testing by both scientists and statisticians. Despite his warning against equating statistical and scientific significance, I fear that decades later the situation is little better, and so I would give this section special emphasis in any educational setting.

Reference:

Rothman KJ. Causation and causal inference. Chapter 2 in Schottenfeld D and Fraumeni JF, eds. *Cancer Epidemiology and Prevention*. Philadelphia: WB Saunders, 1982.