

Conceptions of experimental control in 19th-century life sciences

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Arguably, controls are a key feature of scientific experimentation. However, there are very few systematic studies of concept of experimental control. Historical and philosophical analyses of control experiments have mostly concentrated on randomized controlled trials as “gold standard” for experiment-based inferences in medicine and specifically on the concept of randomization (e.g. Hacking 1988, Hall 2007, Cartwright 2010, Keating & Cambrosio 2012, Parolini 2014). But apart from a paper by Edwin Boring on the nature and history of experimental controls (Boring 1954), broader systematic analyses of the concept of control, the epistemological significance of the practice of controlling, and the conditions of the emergence of the methodological ideas behind experimental controls do not exist. This paper offers contributions to such an analysis of experimental controls. The focus is on the life sciences in the German lands in the first half of the 19th century.

My contribution builds on Boring’s 1954 analysis. I begin my paper with the main points of Boring’s position. Boring helpfully distinguished among three meanings of “control” in the context of experimentation: “control” in the sense of restraint (keeping conditions constant); “control” in the sense of guided manipulation (causing an independent variable to vary in a specific manner); and “control” in the most general sense of check or comparison. He also suggests that John Stuart Mill’s work on the methods of inquiry from the *System of Logic* should be interpreted as the first philosophical conceptualization of controlled experiments, even though Mill did not use the actual term “control”. And he notes that the very term control appears in the scientific literature only in the late 19th century. In the second part of the paper, I argue that it is enlightening to turn the attention away from Mill’s *System of Logic* to working scientists’ own conceptualizations of experimental practice and of methodological strategies of experimentation. Examining the experimenters’ working philosophies reveals that there is a dramatic difference between the pragmatic concerns of the experimenters and the systematic concerns of philosophers. The practitioners often (not always!) perceived Mill’s conception of experimental methods as unhelpful and advanced their own conceptualizations of controls, causes, and complexity in experimentation.

In the third part of the paper, I examine specific examples of practitioners’ conceptions of experimental control. I show that the term control did appear in the early 19th-century scientific literature, namely in the context of experiments on plant growth and plant nutrition in the German lands. A number of experimenters performed agricultural field trials and experimented with novel analytic and culturing techniques to assess the influence of air, water, minerals and organic materials on plant growth. Control experiments [Controlversuche] were a part of these experimental projects. I analyze the meaning of this conception of control and its status in the contemporaneous methodological discussions about experimentation. I also put this analysis in historical perspective, showing that there are two related contexts from which this notion of control emerged: early 19th-century socio-political concerns about controlling populations and methodological discussions in the emerging organic chemistry around 1800. In conclusion, I argue that the early 19th-century examples of “control” in experimental contexts are instructive. My analysis of these early instances of “control” suggests a systematic distinction between two kinds of check and comparison that is not represented in Boring’s threefold distinction of “control” but is well represented in late 19th-century discussions of experimental methods in the life sciences.

References

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