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Invited Scholarly Essay

A Condensed Discussion of Definition and Measurement: "It Don't Make No Nevermind" (Wainer, 1976)

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> We learn how to learn as we learn.
> — Shapere (1984) as quoted in L. Darden (1998, final text before acknowledgments)

I will start with a confession: Many times in my publishing career I have had editors, reviewers, and colleagues tell me where I have fallen short: One critique I've received is that I need to define my concepts *before* I use them and that I should create my measures for these concepts before I conduct my investigation. This sequence—define, measure, then investigate—seems arbitrary and not at all theoretically powerful (see Torgerson, 1958, for measurement by fiat). As a curmudgeon, I have argued against these critiques. In this brief essay, I want to explain why.

When critics indicate that there is a requirement to define concepts before my use of them, I respond that we don't know what the concept is until we use it and determine, by research, its causes and effects. The definitions of theoretical concepts may be far removed from their vernacular definitions. For example, *oxygen* was a term coined in 1777 by French chemist Antoine-Laurent Lavoisier (1743-1794) to indicate "acid generating" (American Chemical Society, 2000). However,

> The element was isolated by Priestley (1774), who, using the old model of chemistry, called it *dephlogisticated air*. **The downfall of the phlogiston theory required a new name, which Lavoisier provided.** (Emphasis added, Online Etymology Dictionary, n.d.)

In other words, the definition of oxygen had to change after a new theory provided the appropriate meaning. Furthermore, if one looks up oxygen in a dictionary today, the meaning will likely be far from Lavoisier's or Priestley's. For example, Oxford Languages defines oxygen as

> A colorless, odorless reactive gas, the chemical element of atomic number 8 and the life-supporting component of the air (Oxford Languages and Google, n.d.),

which is not the exact definition provided by Lavoisier or by Priestley. If we were required to define oxygen before we studied it, our definition would probably have been useless.

What about how to measure oxygen? Priestley's experiments indicated the attributes of oxygen and concurrently how to measure the amount of oxygen in a container. The point here is that definition and measurement were not *prior* to the study of this element, but subsequent to them. As the audience for this discussion, you may want a more precise or clearer definition of measurement and definition. Measurement can be easily explained as a rule for the assignment of numbers to objects based on attributes of the objects. Some terms, such as the weight of a message, may be associated with several attributes (e.g., the message's importance, its amount of information, its discrepancy, its novelty), and we may use multiple items to establish an operational definition in our research; however, we may subsequently be chastised by our colleagues by their suggesting that we do not really *know* what message weight *is*. We may define *definition* (not unreasonably) as the meaning or essential aspects of a word, symbol, or thing. To understand these two concepts (measurement and definition), we examine how definitions and measurements are treated in other science disciplines.

Imre Lakatos, in his book *Proofs and Refutations* (1976), is reported (by Michael Nielsen, on Goodreads) to have

> Radically changed my idea of what mathematical definitions and proofs are, and where they come from. In particular, Lakatos convincingly refutes the idea that definitions come *before* [emphasis added] theorems and proofs (as often seems the case). Rather, they arise out of repeated back-and-forth interplay between conjectures and proof-ideas. (Nielsen, 2019)

In other words, Lakatos argues that the view that we need to define things before we can use them in proofs or theorems is wrong (note that Lakatos's significance as a scholar is indicated by the eponymous Lakatos Award, which is given annually for an outstanding contribution to the philosophy of science).

Many of the most significant scholars of the past hundred and fifty years have tended to agree with Lakatos. For example, Paul Dirac (Nobel Prize in Physics, 1933), in his book *The Principles of Quantum Physics* (1958), wrote that

> The new theories, if one looks apart from their mathematical setting, are built up from physical examples which cannot be explained in terms of things previously known to the student, *which cannot even be explained adequately in words at all*. (Emphasis added, p. v)

> Mathematics is the tool specially suited to dealing with abstract concepts of any kind and there is no limit to its power in this field. For this reason a book on the new physics, if not purely descriptive of experimental work,

> *must be essentially mathematical.* (Emphasis added, p. vi)

> The justification for the whole scheme depends, apart from internal consistency, on *the agreement of the final result with experiment.* (Emphasis added, p. 15)

Albert Einstein (Nobel Prize in Physics, 1921), introducing *Relativity: The Special and General Theory* (1920), asked and answered

> . . . what is meant by motion in space"? . . . In the first place, we entirely shun the vague word "space," of which, we must honestly acknowledge, *we cannot form the slightest conception,* and we replace it by "motion relative to a practically rigid body of reference (railway carriage or embankment) . . . (Emphasis added, pp. 9–10)

Darwin's classic book, *The Expression of Emotions in Man and Animals* (1872/1965),

> did not define the term *emotion*. And in fact, the field of emotion research has found a consensual definition of this term elusive (cf. Frijda, 2000). (Hess & Thibault, 2009, p. 120)

Is measurement an alternative to verbal definition? We suggest that, in science, words may and have failed us, and definitions, mere arrangements of words, have likely failed us as well. But does measurement redeem our science? Let's look more closely.

In 2018, the *definition* of the kilogram was changed, and, as a result, a considerable number of related *measures* changed, as did the theories on which they were based. (Note that, until 2020, there were two different measures of length called a "foot," which were not equal; in 2020, one was eliminated. See Mitchell, 2020).

Newton's theory (c. 1688, with others also properly receiving some credit) involved mass, force, and acceleration as *fundamental measures* (see Torgerson, 1958) and related *derived measures* (also from Torgerson, 1958). These measures were ultimately changed [both in the definition and measurement of these concepts] by Einstein's general and special theories of relativity (1905, 1915).

Zajonc's research on the mere exposure effect (1968), starting with the notion of "mere repetition" of stimuli, ultimately was refined to represent a theory that focused on exposure to subliminal stimuli, thereby changing the way the theory measured and defined "mere exposure."

The elaboration likelihood model (Petty & Cacioppo, 1984) was significantly reconsidered, and some would say invalidated, by the work on the unimodal by Kruglanski and Thompson (1999), which reduced the number of routes to persuasion from two to one, thereby imposing a change on measurement and a change in the definition of the process of persuasion.

The work on Festinger's dissonance theory (1957) took a dramatic turn based on Bem's self-perception theory (1967) and the later work by Fazio and Cooper (1983), Fazio, Zanna, and Cooper (1977), Harmon-Jones (2000), and many others. Indeed, the theory has been modified so many times that as early as 1969 Aronson wrote

> The theory of cognitive dissonance is much more complicated than we thought it was some ten years ago. A good deal of research has been done since then. Many of the problems that were specified earlier have been solved. Hopefully, future research will lead to the study of still more problems, which will lead to more research, which will continue to yield an increased understanding of human behavior. Perhaps this is what the scientific enterprise is all about. (1969, p. 31)

In other words, if the causes and/or the effects of cognitive dissonance change based on new approaches to research in this area, the definitions of the fundamental variables of the theory consequently change as a result, as do the rules for measuring these variables.

Richard Feynman (shared Nobel Prize in Physics, 1965) summarized an aspect of this discussion as follows:

> Science alone of all the subjects contains within itself the lesson of the danger of belief in the infallibility of the greatest teachers of the preceding generation. (As cited in Popova, 2012)

In other words, adhering to our predecessors, "our greatest teachers," may be the wrong thing to add to our scientific canon, although most of us have probably (foolishly?) received comments on our work that criticizes us for wandering too far from "the preceding generation." If Einstein "cannot form the slightest impression" of the word *space*, and other scholars face similar barriers, what should we expect of ourselves and our students?

My dissertation (Fink, 1975) was a study of *embarrassment*, and, of course, my dissertation committee required that I define that term. And I did. But the definition made no difference to my research. And when I have read other research reported by my colleagues and students, I believe that their definitions also pretty much "don't make no nevermind" (Wainer, 1976, p. 213).

The canons for doing science, scientific theory, and measurement include parsimony, generality, abstraction, falsifiability, and surprise (cf. Kaplan, 1964; Kuhn, 1962; Lave & March, 1993; Stinchcombe, 1968; Woelfel, 2016; Woelfel & Fink, 1980). Spending our time tinkering with definitions and measurements that may be arbitrary (see, e.g., Torgerson, 1958) and because it may not be essential to the phenomena under consideration, it is unlikely to advance science, including the science of communication. If you believe that, be prepared for a duel with your mentors and colleagues.

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