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On the philosophical foundations of psychological measurement



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ABSTRACT

Measurement has played a central role in the development of the physical sciences and engineering, and is considered by many to be a privileged method for acquiring information about the world. It is thus unsurprising that the psychological sciences have also attempted to develop methods for measurement. However, it is not clear how the ways in which psychological scientists understand measurement accord with how the concept is understood in other scientific disciplines, or by the professional and general publics. In part this may be due to the ways in which several distinct strands of thinking about scientific inquiry (and measurement in particular) have influenced the work of psychological scientists over roughly the past hundred years. Given that such influences are often not studied or even acknowledged, many psychological scientists may be unaware of the resulting tensions in their conceptual vocabulary, and of the gaps between the nature of their claims on psychological measurement and the substantiation for those claims. The aim of this paper is to overview the major philosophical influences on thinking about psychological measurement, and to note the pitfalls of some of the extreme positions that have emerged. We hope that such an overview may help facilitate greater clarity concerning the semantics of measurement claims made by psychological scientists.

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1. Introduction

Measurement has long been an important and prominent concept in the physical sciences, engineering, and natural philosophy, and is often considered a privileged method for acquiring information about the world (e.g., [38]). Given this, it is unsurprising that the psychological sciences¹ have,

since their inception, developed a variety of techniques that purport to be instances of measurement as well [23,45]. However, it is not clear how the ways in which psychological scientists understand the concept of measurement accord with how measurement is understood in other scientific disciplines, or by the professional and general publics.

An obvious difference between the psychological and physical sciences concerns the nature of the attributes² that commonly come under investigation in each of these fields. In the psychological sciences it is common to hear claims on the measurement of sociological attributes such as ‘cultural capital’ and ‘socio-economic status’, psychological attributes such as ‘anxiety’ and ‘self-esteem’, and more

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¹ The term “psychological sciences” refers here to all scientific disciplines and activities concerned with gaining knowledge of the human mind and behaviour, including not only psychology, but also sociology, anthropology, and disciplines of research concerned with particular human activities such as education, political science, and industrial organizations. Thus, the term is interpreted analogously with the term “physical sciences,” which refers not only to physics but also other disciplines concerned with physical material, such as chemistry, biology, geology, and astronomy.

² We use the term “attribute” to refer both to what are sometimes called “properties” (e.g., mass) and “relations” (e.g., weight, which is a relation between mass and local gravity).

classically academic attributes such as ‘mathematical proficiency’ and ‘college readiness’. *Prima facie*, such attributes appear to be significantly different from physical attributes such as spatial distance and temperature: in particular, psychological attributes would seem to be far less likely to show invariant relations with other attributes or to operate causally in networks of laws, due to the ways in which these kinds of attributes are dynamically indexed to particular cultural, social, and historical conditions. Additionally and relatedly, there is far less agreement amongst psychological scientists concerning the meaning of psychological concepts than there is amongst physical scientists concerning (most) physical concepts; even high-profile attributes such as ‘intelligence’ and ‘depression’ remain controversial. The types of knowledge, skills, abilities, and other personal attributes (collectively, KSAs) targeted by educational programs may seem even less tractable, given that such attributes are, to an important extent, defined by socially, culturally, and historically situated perspectives and concerns, as well as current theories of cognition. The socially dependent (one might say “constructed”) nature of such attributes is at the centre of objections that some traditional understandings of measurement present to the use of the concept in psychological sciences. How can an attribute that is constructed by humans be a quantity, or a *real* property at all? Even if one accepts that such attributes can be modelled as quantities, they are surely resistant to standard techniques of (physical) empirical manipulation such as concatenation, which arguably eliminates them as candidates for ‘fundamental’ measurement ([16]; also see [54, p. 186]); if instead we claim to be able to evaluate their structure indirectly (e.g., via additive conjoint measurement; [33]), how can we deal with the measurement error present in nearly all psychological applications [19]; also see [8], ch. 4?

Finkelstein (e.g., [24,25]) drew a relevant distinction between the measurement of “hard” and “soft” systems, describing the latter in terms of domains that involve “human action, perception, feeling, decisions and the like” [25, p. 269], and noting that invariant relations could likely not be established amongst “soft” systems due to the absence of “adequately complete” and validated theories. A variety of sub-fields in the psychological sciences (including psychometrics, econometrics, mathematical psychology, and psychophysics) have developed techniques that purport to permit the measurement of attributes in “soft” systems, but the claims made in these subfields remain controversial; notably, in recent years, a number of scholars (e.g., [8–10,12,13,11,19,28,34–36,41,43–47,49,50,63,65,67,73,77,78]) have subjected the conceptual and philosophical foundations of psychological measurement to vigorous investigation and critique. The conclusions of these inquiries have often turned up unfavourably regarding both the actuality and even the possibility of psychological measurement (for the former, see in particular [44,45,46,47,49,50]; for the latter, see [77,78]), evidencing that the way in which measurement is understood by psychological scientists may be entirely dissimilar to the way in which it is understood by physical scientists and philosophers of science. Accordingly, at least by some traditional criteria, there may not have yet been any instances of successful measurement of psychological attributes.

In our experience, most members of the mainstream educational and psychological measurement and assessment community are simply unaware of this body of work, as well as the literature on metrology and the history and philosophy of measurement more broadly; further, those who are tend to react dismissively. To the extent to which such dismissals are made explicit, most can be characterised in one of two distinct ways. The first type of response involves acceptance of claims made by scholars such as Michell [92] that “within scientific contexts the term measurement has only *one* meaning and that is as the *assessment of quantity*” (p. 127, emphasis in original) – or at least that there are certain essential features of measurement that may be shared amongst somewhat different instantiations – and that the activities and conceptual vocabulary of psychological scientists are inconsistent with this definition or these essential features. In this case, the concept of ‘measurement’, when used by psychological scientists, would be seen as a metaphor at best (see, e.g., [52]) and a conceptual error at worst. The second type of response involves denial of the premise that the concept of measurement has or needs to have a consistent definition (or even common essential elements) across scientific disciplines; it is thus concluded that psychological scientists and physical scientists may unproblematically maintain entirely dissimilar understandings of measurement. In this case, the word “measurement”, when used by psychological scientists, would be merely a homonym for the word used in other disciplines. In principle, this type of response would need to be accompanied by an alternative account of how measurement concepts are to be understood, especially to the extent to which psychological scientists continue to engage in practices that make use of the logic and vocabulary of classical measurement (as will be exemplified further in later sections); in our experience, however, such an alternative account is generally not given, leaving the concept of psychological measurement and its relation to other forms of measurement nebulous at best. In both types of response there is an implied rejection of the idea that success in the psychological sciences depends on – or, possibly, could even benefit from – conceptualising measurement in a manner consistent with its historical usage in other scientific and philosophical disciplines; this may be associated with a broader rejection of the idea that it is desirable (or, perhaps, possible) for different scientific fields to have common understandings of the practice of measurement.

This largely apathetic or dismissive attitude regarding the meaning of measurement may relate to entrenched traditions in the training of psychological scientists (c.f. [84,79]), which typically contains very little or no direct instruction on the historical and conceptual foundations of measurement. A telling illustration of this point was provided by Borsboom [10], in his review of the most recent edition of *Educational Measurement*, a heavily-cited and highly-regarded volume which proclaims on its own back cover to be “the bible in its field,” in which he noted that “although the word *measurement* figures as prominently in the book as the title suggests, there is no discussion of what it might mean; no discussion of the extant philosophy of science literature on the topic; no discussion of formal

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