

IS PSYCHOMETRICS PATHOLOGICAL SCIENCE?

AN INAUGURAL LECTURE

By

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Introduction

In psychology scientific knowledge is generated and disseminated by means of linguistic constructions or structures such as statements, formulae, models and theories. As psychology is an empirical science, these linguistic structures have to account for empirical observations and integrate the observations into the body of knowledge in a scientifically acceptable manner.

The first challenge is to forge links between theoretical concepts and observations. In psychology the term *construct* is mostly used instead of concept. Kerlinger and Lee (2000, p. 40) explain that: “A *construct* [italics in original] is a concept. It has the added meaning, however, of having been deliberately and consciously invented or adopted for a special scientific purpose.” Attitude, achievement motivation, anxiety and intelligence are examples of such constructs.

Before a construct can be employed in the service of science, its meaning has to be defined clearly and unambiguously. For instance Anastasi and Urbina (1997, pp. 404 – 405) define an attitude as “a tendency to react favorably or unfavorably to a designated class of stimuli, such as a national or ethnic group, a custom, or an institution.” It is evident from this reference that the theoretical construct *attitude* is defined in terms of other theoretical concepts such as favourable or unfavourable reaction, designated class of stimuli, national or ethnic group, etc. This kind of definition is known as a constitutive or theoretical definition.

Even though one can define a construct very clearly and unambiguously in terms of other theoretical concepts, a constitutive definition does not indicate how a theoretical construct is to be linked to observations. What is needed is a different kind of definition which the physicist P.W. Bridgeman² developed in 1927: an operational definition (Michell, 1999). According to Michell (1999, p. 169), Bridgeman defined a concept in terms of its “corresponding set of operations” and not in terms of its “properties”. Thus a person’s height could be defined by the following “operations”: the person should stand on bare feet with heels against a wall; a straight object such as a ruler should be placed on the person’s head and held parallel to the ground; the distance between the floor and the mark where the ruler touched the wall can be measured by placing a calibrated tape measure against the wall and reading the measurement off from the tape; this measurement represents the person’s height.

¹ From Michell (2008).

² Scriven (1969) remarked that although operationism was developed in physics, it was not very successful in that science, however, it did have a huge influence on psychology.

S.S. Stevens was arguably the most influential person in establishing operationism in psychology (cf. Michell, 1999). Stevens coined his famous definition of measurement, “the assignment of numerals to objects or events according to rules” (Michell, 2008, p. 9), of which different versions are found in various textbooks. According to Stevens attributes or characteristics of human beings and their environment can be classified in terms of the extent or degree to which the relevant attribute is present or not. Numerals³ are assigned to the different categories to reflect the degree to which the attribute or characteristic is present. The numbers also represent different levels of measurement that correspond with the different characteristics of numbers. At a basic level numbers differ from each other and one can distinguish among them; this represents the nominal level of measurement. On the next level, numbers can be ranked from low to high or vice versa; this represents the ordinal level of measurement. On the next, the interval level, the intervals between consecutive numbers are of the same size. The highest level of measurement, the ratio level, presupposes a real zero point and consequently meaningful ratios can be calculated among the numbers. These characteristics of numbers are arranged hierarchically with the result that any higher level encompasses the characteristics of the lower levels.

The biggest advantage of these numbers is that they can be used in mathematical operations. Thus, on a nominal or ordinal level the frequencies, proportions and percentages in the different classes can be compared and even correlated. On the interval scale addition and subtraction can be performed while on the ratio scale, multiplication and division can be performed. Sophisticated statistical techniques can consequently be employed to analyse these data. In this manner hypotheses can be tested and the relationships among constructs investigated and eventually models and theories can be developed.

Measuring Constructs

To measure a construct, its constitutive definition is translated into an operational definition in which the rules for its measurement are spelt out. If direct observations are possible, the rules will indicate how these observations are to be made and how the numbers are assigned like in the example of a person’s height given above. Of course measuring a complex attribute or characteristic, for example an individual’s attitude, that cannot be observed directly, becomes quite complicated. In such a case one would try to elicit a response that would serve as an observable indicator of the attribute or characteristic that one is measuring. Suppose, for example, that one wishes to measure taxpayers’ attitude towards politicians. One can construct a self-report questionnaire consisting of questions such as: Are decisions taken by

³ Steven’s use of the term “numeral” rather than “number” is also a debatable point but is not pertinent to the present argument.

politicians in the best interest of taxpayers? Always; Most of the time; About half of the time; Almost never; Never. The numbers assigned to the different responses can be added to give an indication of an individual's attitude towards politicians. A sample of taxpayers' responses to the questionnaire can be analysed to determine whether their attitude in general is negative or positive towards politicians.

Naturally the construction of any measuring instrument is a complex and quite lengthy process during which steps are taken to ensure its reliability (i.e. the consistency with which the instrument measures) and validity (i.e. the extent to which it measures what it is supposed to measure).

According to Kaplan and Saccuzzo (2005) there are indications that the Chinese employed a relatively sophisticated testing programme in their civil service more than 4 000 years ago. This practice was probably introduced to the West by reports from British missionaries and diplomats that encouraged the English East India Company to copy the Chinese system to select employees for overseas duties in 1832 (Kaplan & Saccuzzo, 2005).

Presently there are numerous test and measuring instruments available in the market to be used for selection and placement of employees, performance management, talent management, succession planning, evaluation for, during and after training, career planning and development, change management, assessment of organisational variables such as culture, climate, leadership, etc. These instruments are used extensively in the private as well as public sectors in South Africa and their application in the workplace is regulated by Employment Equity Act No. 55 of 1998 (Section 8) (cf. Foxcroft & Roodt, 2009).

Michell's Critique of Measurement in Psychology

Joel Michell (1999) did a very comprehensive study of measurement theory as it had developed and had been implemented in psychology in his book *Measurement in Psychology: Critical History of a Methodological Concept*. As can be seen from the references to his work above, Michell agrees that the nature of psychological measurement is in essence as it is explained in the present essay. But, even though he does agree with the correctness of the account, he does not necessarily agree with the scientific value of the enterprise. In the preface of this book he already sounds a warning: "This is a book about an error, an error in scientific method fundamental to quantitative psychology. This error became locked into established ways of doing things in that science, that is, it became systemic" (Michell, 1999, p. xi).

Michell (2008) again refers to this error but here he typifies psychometrics as a scientific endeavour as "pathological": "Pathology of science occurs when the

normal processes of scientific investigation break down and a hypothesis is accepted as true within the mainstream of a discipline without a serious attempt being made to test it and without any recognition that this is happening” (p. 7). The hypothesis that Michell (2008) believes is not being tested, refers to “the conviction that psychological attributes – such as cognitive abilities, personality traits, and social attitudes – are quantitative” (p. 8).

Nevertheless, the presence of these oversights in the practice of psychometrics is not enough for it to be called pathological, a “positive factor, one deflecting attention from relevant questions” (Michell, 2008, p. 8) is also required. Michell (2008) believes that there are two sets of vested interest served by this pathology, one ideological and the other economic. On the ideological level measurement is seen as an essential prerequisite of science and if psychology wants to be known as a science, scientists should be able to measure the constructs relevant to the domain. Regarding the economic interests, Michell refers to the marketing and selling of measuring instruments peripherally only. He believes the biggest economic spin off is in terms of the funding of research. As psychology claims to possess a rigorous scientific methodology which is to a large extent due to its ability to measure relevant constructs, it finds itself in the fortunate position to justify larger grants for research projects.

In terms of Michell’s (2008) own admission this pathological state of psychology has been in existence for more than 100 years and despite it, or perhaps because of it, psychology has been doing very well. Although he warns that “[a] cognitive system is pathological when it prevents rather than promotes acquisition of relevant knowledge” (Michell, 2008, p. 7), it is not clear from his submission exactly what the “irrelevant knowledge” is that he is referring to. This is now unless he is actually referring to his survey of literature on psychometrics which “reveals a body of theories, methods, and applications premised upon the proposition that psychological attributes are quantitative but is devoid of serious attempts to consider relevant evidence for that premise” (Michell, 2008, p. 8). Thus it seems as if his main complaint is that no attempt had been made and is being made to determine whether psychological traits are in fact inherently quantitative and as such are measurable. According to Michell in Stevens’ version of operationism that was accepted in psychology, the scale level (nominal, ordinal, interval and/or ratio) is linked to the type of admissible transformations (in terms of the rules of mathematics) which the test scores may be subjected to, instead of investigation the inherent structure of the relevant attribute (p. 10).

“If you are going to seriously test the hypothesis that some latent trait, X , is quantitative, then X must be specified in sufficient detail for its hypothesized quantitative structure to have a theoretical interpretation in terms of item structures and the psychological processes” (Michell, 2008, p. 15). According to Michell (1999) there are two tasks to be performed in measurement. Firstly there is the scientific task to discover the quantitative structure of the attribute to be measured

and secondly an instrumental task to construct an instrument to measure the relevant attribute. But, he concludes, “if Stevens’ definition of measurement is accepted, then the scientific task of quantification is cancelled and only the instrumental task remains” (Michell, 1999, p. 77).

The next question to answer is what does Michell mean by the “quantitative structure” of an attribute? In order for an attribute to be measured one should be able to link units of the attribute to corresponding (usually positive) real numbers in order to form ratios (see Michell, 2005, p. 287). “This position entails that *measurement is the attempt to estimate the ratio between two instances of a quantitative attribute, the first being the magnitude measured, and the second being a known unit*” [Italics in the original] (Michell, 2005, p. 287).

From Michell’s exposition it is clear that he is a proponent of realism and as such believes that a spatio-temporal reality exists, independent from observations, and that this reality is of such a nature that its characteristics can be measured by assigning numbers, which also exists in reality, to units of these characteristics. Michell (2005, p. 287) explains his view as follows: “To summarise the realist position: understanding measurements under the umbrella of the realist concept of truth, commits us not just to the logically independent existence of things in space and time, but also to the existence of quantitatively structured properties and relations, and to the existence of real numbers, understood as relations of ratio between specific levels of such attributes”.

According to Michell (2008) at best one can assume that the attributes that one measures in psychology have an ordinal structure. For example in the case of intelligence, where one would require a higher level of intelligence to do a specific item than another easier item but would be unable to specify the exact quantity (in order to form a ratio) of the relevant ability that is required to do the more difficult item. Consequently intelligence does not have a quantitative structure and as such cannot be measured.

Realism, Representationalism and Phenomenalism

Traditionally the question about what can be known about the external world may be answered in three different ways, that represent i) direct realism (also called naive or common sense realism), ii) representationalism and iii) phenomenalism respectively (Pojman, 2006). Proponents of direct realism claim that the immediate objects of our perception are physical objects that exist in the world independent of our awareness of them (Poyman, 2006). From the viewpoint of representationalism and phenomenalism the immediate objects of perception are sense data (or impressions) that do not have an existence independent of our awareness of them (Poyman, 2006). Pojman explains that according to both these viewpoints sense data are internal representations, such as colours, shapes and sizes, of appearances in our

minds, but representationalism and phenomenism differ from each other with regard to the nature of the relationship between sense data and the physical world. According to proponents of representationalism the physical world exists independently of our perceptions and causes our perceptions whereas supporters of phenomenism assume that there is nothing beside sense data in the world.

The biggest dilemma that proponents of direct realism face is that it is impossible to bridge the gap between physical objects that exist in the world independently of our senses and our representation of these objects. It is apparent from physics that our senses do not give us an exact replica of the things in the real world. For example, colour is not a property of things around us but the way our eyes experience the reflection and refraction of light of different frequencies. While even the most solid seeming structure, such as a wall, actually consists mostly of space filled with subatomic particles perpetually in motion. Inevitably supporters of realism cannot justify their belief in the independent existence of the real world or their knowledge of it, and as such acceptance of realism unavoidably leads to scepticism.

As far back as during the 16th century the German philosopher Immanuel Kant (1724 – 1804) addressed the predicament of gaining knowledge about what lies beyond human experience (Law, 2007). Kant differentiated between, on the one hand the real world that lies beyond our experiences and about which we cannot have definite knowledge, and on the other hand, the world as it appears to us and about which we can have knowledge (Law, 2007; Pojman, 2006). He called the former “noumena” (or the “ding an sich”) and the latter “phenomena” (Law, 2007, p. 297; Pojman, 2006, p. 239). Kant proclaimed that we as human observers actively impose a structure on reality by means of the internal forms of our mind such as space, time and causality (Pojman, 2006). Kant’s philosophy represented such paradigm shift from the views of previous philosophers that it was likened to the Copernican revolution in astronomy: Copernicus (1473 – 1543) caused a revolution in astronomy when he postulated that instead of explaining the movement of the sun, stars and planets around a fixed observer on earth, it should rather be acknowledged that the observer is also revolving with the other heavenly bodies around the sun (see Law, 2007; Poyman, 2006).

In terms of the distinction among realism, representationalism and phenomenism made above, Kant’s philosophy represents representationalism because he believed that the physical world exists outside and independent of our experience and that we do not have direct access to it. According to him we understand the world in terms of the categories of the mind such as space, time and causality that we impose on the totality of our experiences (Pojman, 2006).

The Relationship between Ontology and Epistemology

Perhaps at this stage it would be useful to define the two concepts ontology and epistemology and to discuss the relationship between them. Ontology is the study of the essence of being or, in other words, the nature of things whereas epistemology is the study of the nature of knowledge i.e. a theory of knowledge. In the sciences an epistemology would include a philosophy of science as well as a methodology (theory of method) applicable to the relevant science. It stands to reason that ontology and epistemology are interdependent in the sense that an epistemology must provide the theoretical background as well as the methodology to study and gather knowledge of the things in the world while the ontology should define the things in the world in such a manner that they are amenable to be studied.

Therefore, in terms of Kant's epistemology, the human observer knows the things in the world by means of structures in the mind while in terms of his ontology the things in the world have an existence independent of the human observer in the sense that that they cannot be accessed directly by such an observer. Most of Kant's philosophy concerns the limits of epistemology and the supposition that, in terms of his ontology, the real world (noumena) cannot be known. Eventually he developed his own version of idealism which, as explained above, led to a revolution in Western philosophy.

Constructivism

Since the time of the Greek philosophers (from about 600 BC, according to Law, 2007), viewpoints alternating between idealism (reality is a creation of the mind and one should study these ideas to know reality) with a corresponding rationalism (the mind is the source of knowledge and through innate ideas and reason (logic) alone knowledge is created) and realism (reality exists independently of the mind where it should be studied) with a corresponding empiricism (experience is the only source of all knowledge and there are no innate ideas to serve as a source of knowledge) were advocated. In this ongoing debate Kant's philosophy represented a turning point as he offered a way of reconciling idealism and rationalism with realism and empiricism in which the investigator played a major role. Subsequently a number of viewpoints, for example positivism, logical-empiricism, phenomenology, hermeneutics, constructivism, systems theory and postmodernism to name but a few, were developed to address philosophy's ubiquitous conundrums.

Of these philosophical views I would like to employ constructivism and a reference to systems theory to address the issue presented in the present discussion.

Delanty (1997) explains that according to constructivism social reality⁴ is not something outside of scientific discourse, rather it is constituted i.e. constructed by science. The investigator plays an active role in creating scientific knowledge in comparison to the justificationist/received view philosophies in which knowledge already exists in the world and the role of the investigator is to unveil it objectively, without prejudice. Social scientific knowledge is not a creation of the mind like in idealism, but it is knowledge created by mediation between the structures of science and reality and as such it is a construction designed to produce knowledge of its subject matter (cf. Delanty, 1997). Generation of social scientific knowledge it is always restricted by the confines of its own methodology consequently constructivism “entails a degree of ‘self-referentiality’ or ‘reflexivity’” (Delanty, 1997, p. 112).

However, Luhmann (2003) warns that an acceptance of the tenets constructivism does not ipso facto imply that the concept ‘idealism’ has been exchanged for ‘constructivism’ because there has been a major shift in emphasis in dealing with the conflict between idealism and realism. According to Luhmann (2003) is not helpful to begin the quest for knowledge with Kant’s question about the possibility of knowledge as it might guide our argument to a premature closure. It is more appropriate to ask how one can distinguish knowing from what it is not (Luhmann, 2003). Luhmann (2003, p. 438) argues as follows: It is not productive to begin the analysis with the age old question whether the knowing system is a subject or an object. The dilemma for subjectivism is to demonstrate how it is possible to know the world of others from the reference point of one’s own mind. The idea of knowers sharing intersubjective knowledge does not circumvent this problem. On the other hand, the claim of supporters of objectivism that a particular object or organism can be known completely without referring to its relationship with its environment is also indefensible.

In order to evade this dilemma Luhmann (2003, p. 438) suggests that both the subjectivist and objectivist theories of knowledge be replaced by a system-environment distinction which would make the subject-object distinction irrelevant. However, Luhmann warns, this does not mean that the existence of a reality is questioned, for such a denial would also undermine constructivism. What is questioned is the epistemological relevance of a specific ontological representation of reality.

How is scientific knowledge generated within a systems theoretical constructivist approach? As gathering knowledge is a cognitive enterprise, the brain of the knower serves as the instrument of cognition. According to Luhmann (2003) most of the stimuli reaching the brain are erased within fractions of a second while very few are retained for longer periods. This implies that the brain is continuously and

⁴ Constructivism was developed within the ambit of social sciences and as such the reality under consideration is the social reality.

instantaneously selecting and rejecting stimuli. Furthermore, it seems essential for the functioning of the brain that selected material is isolated “[a]s if it were already information (or data) before it motivates the brain to form a representation” (Luhmann, 2003, p. 439).

To understand the process of generating perceptible knowledge further, it becomes necessary to distinguish between operation and observation: “An operation that uses distinctions in order to designate something we will call ‘observation’. We are caught once again, therefore, in a circle: the distinction between operation and observation appears itself as an element of observation. On the one hand, an observation is itself an operation; on the other hand, it is the employment of a distinction” (Luhmann, 2003, p. 440). Luhmann (2003, p. 439 - 440) explains the role of operations and observations within the system as follows: “Operations of this kind are only possible within the context of a network of operations of the same system towards which they point and on which they are founded. There is no single operation that can emerge without this recursive network. At the same time the network itself is not an operation. ‘Multiplicity does not act as a relay.’ The whole cannot as a whole itself become active. Every operation reproduces the unity of the system as well as its limits. Every operation reproduces closure and containment. There is nothing without an operation – no cognition either.” Science is a closed system (having no connection to things that are not science) that is self-perpetuating in the sense that it is self-generating or “autopoietic” (Delanty, 1997, p. 124).

Conclusion

Taking the discussion above into consideration, one may probably answer Michell's question with a yes or a no. If one accepts the tenets of realism, one may agree with Michell and accept that psychometrics is indeed pathological. On the other hand, if one considers the philosophical objections against realism raised above, one would support constructivism instead.

In addition to contemplating the issue on a philosophical level, one may also address it at a methodological level. Here psychology as an empirical science is confronted with the dilemma that attributes of human beings such as intelligence, attitude, self-belief, etc., cannot be compared directly with or are not analogous to attributes of physical entities such as length or mass. For one, the units of the latter kinds of attribute are predetermined and standardised. The metre was defined as a distance between two marks on a bar of platinum-iridium (supposedly one ten-millionth of the distance from the North Pole to the equator) and the kilogram was represented by a cylinder of the same metal with a mass of exactly one kilogram (Chang, 2005). According to Chang these two standardised units are kept in a vault in Paris. More recently these units of measurement have been redefined in an attempt to base them on the universal constants of physics i.e. the speed of light and the charge of

an electron (cf. Chang, 2005). This implies that the measurement of attributes like length and mass now becomes interwoven with theoretical aspects of physics and that the unit of measurement can be established independently by individual researchers without referring back to the units kept in a centralised place. It also represents a shift from viewing measurement as a comparison of units of an attribute with units of a measure to a realisation that measurement is accomplished against the background of theory; the latter representing a constructivist approach rather than a realist approach.

Instead of visualising human attributes in terms of measurable units that can be compared with a standardised unit as Michell proposes, it makes more sense to understand such attributes in terms of a process theory regarding the interaction of individuals with their environment.⁵ Definitions of constructs and items of measuring instruments are developed in terms of relevant theory, and norms and criteria against which individuals are assessed are standardised with reference to appropriate peer groups. Psychologists make observations of humans interacting with their environment and distinguish between what is scientific knowledge and what not. In this manner science represents a self-generating, self-correcting structure as proposed by Luhmann above.

⁵ Oosthuizen and Van Lill (2008) discuss such a model of stress in the workplace.

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