

ON THE VALIDITY OF MEASUREMENT IN KINESIOMETRICS
CONTEXT*Franjo PROT*¹¹ University of Zagreb, Faculty of Kinesiology, Horvaćanski zavoj 15, 10000 Zagreb, Croatia
e-mail: pipo@kif.hr*ABSTRACT*

Kinesiometrics is a scientific discipline which deals with problems of measurement in kinesiology, with the development of new theoretical and applied measurement models and with practical procedures in the field of the measurement of behavior relevant to kinesiology. In this document, contribution validity (one of the most important concepts) is systemized and organized from the general bird's-eye view, taking into the account the psychometric heritage and kinesiometric experience. In the first step we recognize the traditional separation of validities into two major groups, i.e. as validities a priori (in psychometrics aprioristic validities) and validities a posteriori. These two groups are further splitted and divided into several groups and up to four levels, up to the point where concrete data analysis methods and techniques could be recognized for its determination. To be able to recognize most of the problems encountered in grasping validity in its diversity acceptable systematization would be of great help.

Keywords: measurement, validity, kineziometrics

VELJAVNOST MERJENJA V KONTEKSTU KINEZIOMETRIJE

IZVLEČEK

Kineziometrija je znanstvena disciplina, ki se ukvarja s problemi merjenja v kineziologiji ter raziskovanjem novih teoretičnih in uporabnih modelov merjenja, na katerih temeljijo postopki merjenja, ki so pomembni za področje preučevanja kineziologije. V tem prispevku je veljavnost, kot eden najpomembnejših okvirov za sistematično organiziranost predstavljen iz "ptičje perspektive", pri čemer upoštevamo psihometrično ozadje in kineziometrične izkušnje. V prvem koraku priznavamo tradicionalno delitev veljavnosti v dve glavni skupini, to sta predhodno preverjanje veljavnosti in naknadno preverjanje veljavnosti. Ti dve skupini se v nadaljevanju delita v več skupin do četrte ravni, vse do točke, kjer lahko opredelimo in določimo konkretne metode analize po-

datkov. Ob zavedanju problemov, povezanih s zagotavljanjem in razumevanjem veljavnosti v vsej svoji raznolikosti, bi bilo sprejetje sistematizacije v veliko pomoč.

Ključne besede: merjenje, veljavnost, kineziometrija

INTRODUCTION

Kinesiology, in its development from the early 1970's, absorbed much of its achievements from psychometrics, which was already well founded and developed as a pure and applied discipline among psychologists. The origin of the term kinesiology "kineziometrija" in its contemporary context can be traced back to Zagreb's kinesiol-

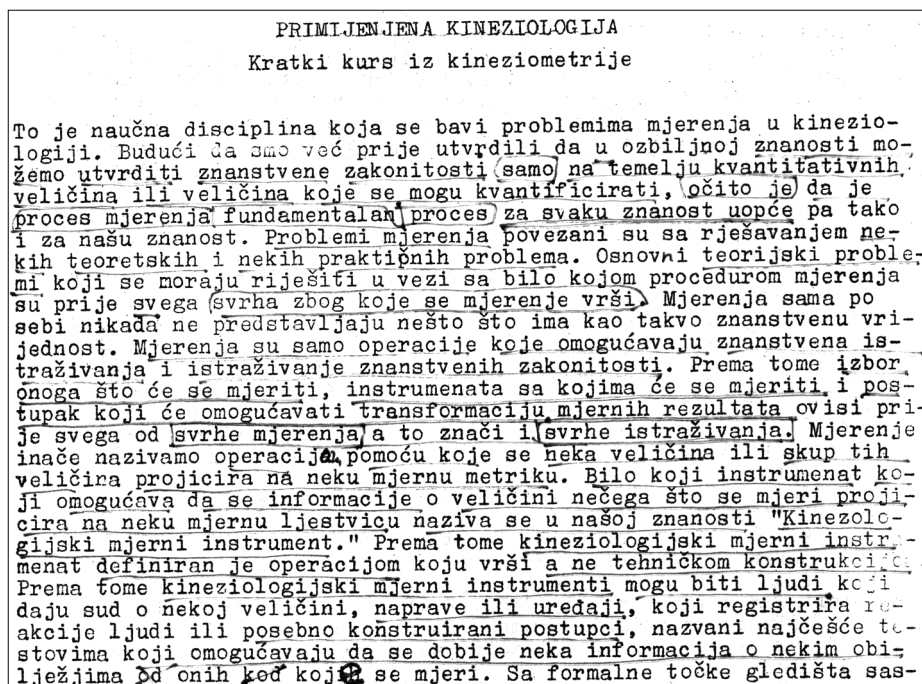


Figure 1: A part of the first page of student notes from an audio recording for the first course on Kinesiology ("kineziometrija") from the postgraduate study of Kinesiology, from the years 1971-72 at the College of Physical Education (currently the Faculty of Kinesiology).

kineziometrija, statistika: naučna disciplina koja se bavi problemima mjerenja u kineziologiji.

Figure 2: Definition of the term “kineziometrija” kinesiometrics on page 201 of the *Sport Lexicon* from 1984.

-kineza, -kinezija, -kinetički kao drugi dio riječi označava ono što se odnosi na kretanje, gibanje; pokretan, kretni [*diskinezija*] ⇨ *grč.* kínēsis: kretanje; kinētikós: koji pokreće

kinezi-, kinezio- v. kine-

kinezàlgija ž *med.* bol koja se javlja pri kretanju, osobito kod mišićnih napora ⇨ KINEZI- + -ALGIJA

kineziologija ž **1.** znanost o gibanju, kretanju; istražuje zakonitosti posebno uvjetovanih tjelesnih vježbi
2. studij na sveučilištima, ob. studij tjelesne kulture
⇨ KINEZIO- + -LOGIJA

kineziomètrija ž *term.* znanstvena disciplina koja se bavi problemima mjerenja u kineziologiji ⇨ KINEZIO- + -METRIJA

Figure 3: The term kinesiometrics “kineziometrija” was introduced to Anić-Goldstein’s dictionary on page 675 (Anić & Goldstein, 1999).

ogy circle (Momirović, 1971; ***, 1984; Anić and Goldštajn, 1999, 2002; Prot, 2008), from the level of lecture notes up to the lexical item in the lexicons and dictionaries (Figures 1., 2. and 3.).

Kinesiometrics is a scientific discipline which deals with problems of measurement in kinesiology. Kinesiometrics deals with the development of new theoretical and applied measurement models and practical procedures in the field of the measurement of human movement behavior relevant to kinesiology. Applied kinesiologists i.e. physical education teachers, physical fitness and sport and recreation professionals shared similar problems. One of their objectives is to develop a reliable and valid measurement which will allow diagnostic and prognostic operations estimating the level of success of individual participants in criterion variables. The validity was and is the key concept. To be able to recognize most of the problems encountered in grasping it in its diversity, acceptable systematization would be of great help. An implicit and explicit contribution to the development of a deeper insight with the elements of systematization could be traced back to psychology and psychometric sources such as: Radosavljević (1908,

1909), Radosavljević (1910), Guliksen (1950), Bujas (1954), Guilford (1954); Cronbach (1960), Momirović (1966), Wainer and Brown (1988), Jones and Tissen (2007), Kingston (2007), with the permanent diffusion of new psychometric developments to other fields. The development of The Standards for Educational and Psychological Testing of the American Psychological Association (1999) also demonstrate an evolution of concepts.

The founding symposium on establishing an International Kinesiometrics Forum in Koper at the Universtiy of Primorska held on 21st May, 2009, seemed to be the most appropriate place to discuss validity as topic of interest and was dedicated jointly to the memory of two extraordinary scholars and teachers who contributed to the development to kinesiometrics in Europe before its formal foundation; these were namely Professor Konstantin Momirović and Professor Stanislav Čelikovský. In this contribution, concepts of validity are systemized and organized from a bird's eye view, taking into account kinesiometric developments and experiences.

Systematization of validity

Within one hundred years of the gradual accumulation of knowledge and experience, it is possible to distinguish principles which are of theoretical and educational value and which offer a natural extension to systematization. The main result of this contribution is summarized by Table 1 and Figure 4.

At the beginning of the inquiry, we postulated the principle which we use for our investigation of validity, that is, we will accustom phylosophical, i.e. epistemological groundflore that a priori knowledge or justification is independent of experience; and a posteriori knowledge or justification is dependent on experience or empirical evidence. A priori valdity of the construct subsumes the types of justifications and methodologies face, content, and theoretical aspects. A posteriori validity of construct subsumes all of the procedures which can be operationalized and verified as data analysis techniques. As posteroiry internal (construct) and external (pragmatic) validities are identified. Internal validity is preented with intra and inter subtypes. Intra subtypes are a latent trait (factor validity), as noticed by Momirović (1966) and a latent class (taxonomic validity), as noticed by Momirović, Wolf, Džamonja and Hošek (1993). Inter validities split into the two sub types, i.e. convergent and divergent validities. External validity with sub types concurrent (diagnostic) and predictive (prognostic). Further on sub types are formed on the basis of quantitative/qualitative representation metrics of data to be collected. In this way, these main categories are further divided introducing further additional principles not contradicted to those already previously established. This process continues up to the point where concrete data analysis methods and techniques could be recognized for its determination, for example Hayashi (1980). In this way, the validity concepts are presented from a general macro level to the micro level of data analysis

methods and techniques which are employed in its determination in kinesiological research. The four strata levels are sufficient for a general approach. More data analysis specific sub taxonomy is generated from the fifth stratum on.

Table 1: Systematization of validity of measurement in kinesiological context (an outline presentation).

0.0 VALIDITY OF MEASUREMENT

1.0 a priori (theoretic, hypothetic, aprioristic) validity of the construct

1.1 face validity

1.2 content validity

1.3 theoretic validity

2.0 a posteriori (empirically determined) validity of the construct

2.1 internal validity (symptomatic)

2.1.1 “intra validity“ (content referenced)

2.1.1.1 latent trait (factor) validity

2.1.1.1.1 explorative factor validity

2.1.1.1.2 confirmative factor validity

2.1.1.2 latent class (taxonomic or cluster) validity

2.1.1.2.1 explorative taxonomic validity

2.1.1.2.2 confirmative taxonomic validity

2.1.2 “inter validity“ (construct referenced)

2.1.2.1 convergent validity

2.1.2.2 divergent validity

2.2 external validity (exterior criterion referenced), (pragmatic)

2.2.1 concurrent (diagnostic) validity

2.2.1.1 quantitative criteria

2.2.1.2 qualitative criteria

2.2.2 predictive (prognostic) validity

2.2.2.1 quantitative criteria

2.2.2.2 qualitative criteria

Here, we finally go further into the level of statistical and data analysis reasoning and arguments which strongly influence an outcome of systematisation: Lord and Novick (1968); Hayashi (1980), Momirović, and Gredelj (1980); Bujas (1981); Ferligoj, Leskošek and Kogovšek (1995); Momirović, Wolf and Popović (1999); McDonald (1999), Gliner and Morgan (2000), Rowe and Matew (2006), Wood and Zhu (2006), Zhu and Venter (2006), Zumbo (2007), for example. In this way, it is possible to distinguish the linear and nonlinear, the relatively simple, straight forward to the more complex and more structured algorithms. It is interesting to point out that the multivariate

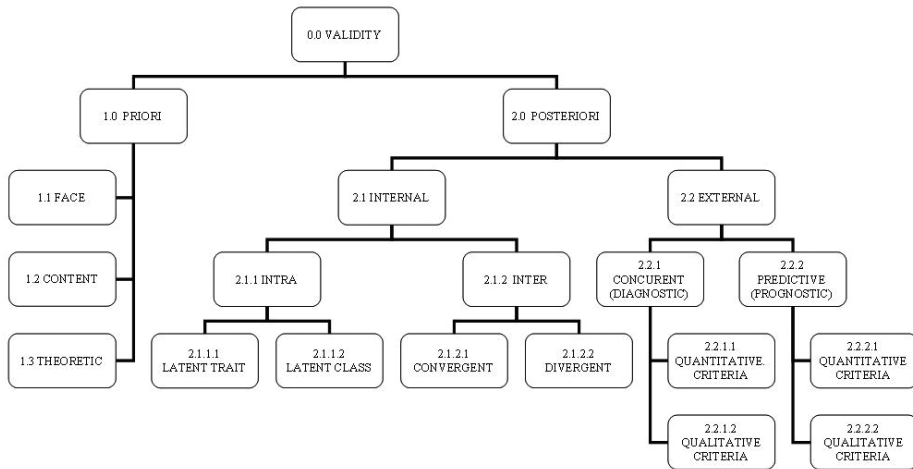


Figure 4: Systematization of validity of measurement in kinesiometrics context.

nature of the problem has been stressed several times. But initial enthusiasm with canonical correlation as a general approach: Hotelling (1936); Guliksen (1950); Mekota and Blahuš (1983), raised some doubts and offered criticism (Cohen and Cohen, 1983, 2003). Some alternatives were offered as the problems were attacked from different directions: Tucker (1958); Momirović. (1971); Momirović, Štalec and Zakrajšek (1973); Momirović, Dobrić, and Karaman (1983); Bosnar, Prot, and Momirović (1984); Hošek, Bosnar, and Prot (1984); Momirović, Štalec, Prot, Bosnar, Pavičić, Viskiđ-Štalec and Dobrić (1984); Momirović, Bogdanović, Tenjović and Wolf (1994); Knežević and Momirović (1996), sometimes with a more general approach and sometimes with more particular solutions.

CONCLUSION

The synthesis of developments from psychometrics and experiences and the development from kinesiometrics is possible. The systematization of concepts of validity up to the level of methods of their determination is presented. Enumeration of all of the previously proposed and presently available methods which will further fit in to the systematization seems to be one of the next obvious research steps.

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