

## **REVIEW**

**By Assoc. Prof. Georgi Iliev Petkov, PhD, Institute for Population and Human Studies, Bulgarian Academy of Sciences (BAS)**

**In regard with decision No. 7 of 07.02.2023. of the Faculty Council of the Faculty of Philosophy at Sofia University "St. Kliment Ohridski" for the defense of full-time doctoral student Ivaylo Georgiev Panov to a doctoral program in a professional direction: 3.2. Psychology, General Psychology (Psychological Measurement and Assessment - Psychodiagnostics)**

**I present this review as a member of the Scientific Jury for the cited defense, on the basis of an order of the Rector of SU "St. Kliment Ohridski", in regard with decision No. 7 / 7.02.2023 of the Faculty Council, on the basis of Art. 4 of the Law on the Development of the Academic Staff in the Republic of Bulgaria (promulgated SG No. 38 of 21.05.2010, amended by SG No. 81 of 15.10.2010, amended by SG No. 101 of 28.12. 2010 r.; amended No. 68 of 08/02/2013, effective from 08/02/2013; amended and supplemented, No. 30 of 04/03/2018, effective from 05/05/2018).**

**Author of the dissertation: IVAYLO GEORGIEV PANOV**

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**with supervisor: Assoc. Prof. Dr. Ivan Nikolov Bardov, PhD**

**Dissertation topic:**

**CAPABILITIES OF THE COMPARATIVE SCAN METHOD (cSM) IN THE ANALYSIS, VISUALIZATION, AND PSYCHOLOGICAL INTERPRETATION OF "PREFERENCE CHOICE" EXPERIMENTAL DATA**

**Reviewer: Assoc. Prof. Georgi Iliev Petkov, PhD,**

**Institute for Population and Human Studies, Bulgarian Academy of Sciences**

### **1. General description of the presented materials**

As a member of the Scientific Jury for the competition, I have received the necessary documents: an order from the Rector of the SU, a curriculum vitae, the text of the dissertation (260 pages), an abstract (68 pages), a signed Declaration of Authenticity and Originality acc. Art. 27, para. 2 of the PP ZRASRB, a completed table with the number of points by groups of indicators, according to the requirements of NACID, a list of author's publications related to the dissertation.

**According to the submitted documents, Ivaylo Georgiev Panov meets all the legal requirements for the defense of a doctoral dissertation.**

### **2. Brief biographical data**

Ivaylo Panov holds a bachelor's degree in psychology from the New Bulgarian University and a master's degree in cognitive science from the New Bulgarian University. He has a significant number of post-graduate qualifications held in Bulgaria and in the USA - under the programs of "World Learning", "Marketing and Advertising in Tourism", "Operational Accounting", "Education Technology Directors' Program" and others. He has a remarkable professional work history – he has worked as a psychologist in various places for more than 20 years. He speaks perfect English and has excellent computer skills. He has published 2 books and more than 15 publications. He participated and led scientific projects.

### **3. General characteristics of the dissertation work**

The work is 260 pages long and contains all the necessary components for a dissertation - title page, table of contents, introduction, theoretical framework, description of a new psychophysical method, description of software development on it, a series of empirical verificational psychological studies for demonstration of the qualities of the method and software developed, a conclusion, a list of references and eight appendices. An abstract is attached. The dissertation is structured in three main chapters – theoretical description of the method; software implementation; and empirical data on it.

The work is a combination of methodological development and empirical psychophysical research. The development and improvement of methodological tools is extremely necessary for modern psychology and is always relevant. Psychophysical research covers extensive and heterogeneous areas of psychology - from subjective preferences in visual perception through the role of the spatial arrangement of elements of text (architectonics) for better perception of information, to abstract characteristics of personality psychology such as value systems. This breadth of researched areas aims to demonstrate the universality of the developed psychophysical method (and succeeds in doing so), but at the same time contributes to a better essential understanding of the psychological constructs studied.

The structure of the dissertation is excellent. Explicitly, clearly and unequivocally are formulated the subject of study; the goals, the research objectives. All necessary components are well

defined - theoretical overview, description of the method, instructions for its software implementation, empirical verification of the method, conclusions.

I would point to page 51 as an example of an excellent style of writing a scientific text, where a list of fundamental questions about the reference stimulus is asked, followed by a clear and unambiguous explanation of which of them the paper is relevant and which of them are not.

The graphics and illustrations to the text are illustrative and well described, which contributes to the good readability of the otherwise relatively difficult material.

The appendices occupy more than 20% of the total volume of work and are well selected. On the one hand, they give completeness and correctness to the description, and on the other hand, their isolation in appendices is correct in order to facilitate the reading of the main text.

The bibliography contains 86 titles, of which 51 are in English. This is a significant volume of reference literature and covers the bulk of relevant works on the topic. The author's publications on the subject of the doctoral studies are 11, of which 2 are books.

Some minor remarks according the style:

(1) The introduction looks more like an abstract than an introduction to the topic. The text would have been more interesting to a wider readership if the introduction had focused more on the utility of the comparative scanning method for psychological research (mentioned on pp. 8, 9 and then well expanded on in the final pages of the introduction) and for our understanding about psychological constructs, rather than on some of its specific psychophysical characteristics (e.g., S-shaped and linear distributions (p.8)), technical details on software versions (p.14), and a complete long list of studies that will not be described clearly until later in the dissertation.

There are in the introduction also some deep reflections on yet undefined concepts. Just one example - on page 16, in the description of the second study, difficult questions are asked about the reference stimulus. However, the reference stimulus has not yet been defined (only later on page 23 there will be an initial explanation of its meaning). From the point of view of a reader reading the text sequentially, the questions would still be incomprehensible. One of the roles of the introduction is precisely to provide initial, intuitive definitions of such concepts.

(2) The theoretical overview (Chapter 1) is in the style of a textbook. The material would be even more enjoyable for reading if the focus had not shifted away from the main topic - cSM, and all the rest - methods, paradigms, theories, approaches... were revealed gradually through their connections with cSM.

***In summary, the structure, bibliography, writing style, clarity and correctness in defining the research objectives, objectives and other components cover the requirements for writing a scientific text.***

#### **4. Assessment of the content and main results of the dissertation research**

The dissertation is huge not only in volume, but also in content. An innovative psychophysical method is proposed; software developments on it and as many as 12 empirical studies that verify it.

The proposed cSM method is described comprehensively and correctly in Chapter 1, point 2. The concepts used and their connections with those of other computational methods used in psychology are clearly defined. A fair comparison is made between the capabilities of cSM and other widely used methods such as multivariate scaling, factor analysis and some statistical methods for hypothesis testing.

Providing the developed software as a free product accompanied by installation and usage instructions is commendable.

A significant emphasis in the dissertation work is placed on the difference between the so-called nomothetic and idiographic approach, i.e. whether the important psychological characteristics are to be sought in the relationship between the individual and the population or in the relationship entirely within the individual. This in itself is a complex and important scientific, methodological and philosophical topic.

Almost half of the volume of the dissertation is occupied by the description of 12 psychological studies demonstrating the possibilities and establishing the validity and limitations of the proposed method. This is an extremely large amount of work. A total of more than 1,000 people were studied, including small children, blind people, etc. Such diligence in method validation is rare and deserves explicit praise.

The universality of the method has also been successfully demonstrated – it can be applied both to concrete perceptual stimuli and to abstract ones.

A significant contribution is the demonstration of the fact that the averaged data across participants can differ greatly from the averaged results for each individual participant (e.g., in Experiment 3). This in itself is an important result whose applications, as well as the questions it raises, go far beyond the particular cSM method.

The golden section experiments (Experiments 4-6) are very interesting and again the results have significance beyond demonstrating the capabilities of the cSM method. At the same time, they raise questions related to the basic assumptions of the method, as well as other psychophysical methods. For example, it would be interesting to examine how results would change if participants were primed by a prior manipulation to pay more attention to area (or contrast) than to length. If this significantly changes the results, then the question naturally arises as to how stable the reference stimuli and spaces are over time, or whether they are valid in a particular context only.

Experiments 7 and 8 are outside the main topic and perhaps did not need to be included in the thesis.

Experiment 9 touches on the important area of education. Of course, specifically in the thesis, it should be considered as part of the validation of the cSM method, now with more complex (though again essentially perceptual) stimuli. This task is complete. In addition, the comparison between the

results of Experiment 3 and Experiment 9 provides a great illustration of the capabilities of the model and how to interpret different results from it. An under-discussed question is the extent to which we can even conclude that there is a single real reason for the demonstration of similar preferences, given that the matching factor yields relatively high values (I'm talking about Experiment 9, p. 133).

In the last series of experiments, three more tasks of the tool's validation were successfully completed: First, it was demonstrated that cSM can be applied to highly abstract stimuli as long as the presumption of a finite number of metrical dimensions in the stimuli is valid. Second, it is shown how cSM can be used complementary to other computational procedures, e.g. with factor analysis. Third, a specific validation of the cSM is presented by directly comparing the results obtained through it with those of another commonly accepted instrument. Logically, it seems to me that Experiment 11 should precede Experiment 10, i.e. to first use factor analysis to determine some dimensions, and only then to apply cSM using the resulting dimensions as a presumption.

**One critical remark:** Something about the null hypotheses remains unclear. I will illustrate this with the example from Experiment 1: On page 86, a hypothesis is formulated: "If a set of physical (visual) stimuli is selected from a predefined feature space according to the requirements of cSM, then in this space there exists a subspace - REFERENCE ZONE of the subject ". The results are then shown and it is concluded that the hypothesis is confirmed. However, it is not clear what are the expected results if the null hypothesis is true. That is, if there is NO "subspace - REFERENCE AREA of the subject", then what would we observe as a numerical value (and as pictures) in the results? Specifically, what is the match factor critical point and how is it determined? It is claimed that on Fig. 30 the reference zone of a randomly selected subject can be seen. But what would one see if the hypothesis WERE NOT TRUE? How do we compare the two "views"? Interestingly, on page 91 it is concluded that "There is no universal reference zone with respect to the experimentally defined feature space." (This is a nomothetic analysis, i.e. after averaging over all participants). So basically there is a possible result showing no reference zone and the author knows it (perhaps some critical point of the calculated 'coincidence factor', but that's just my guess). He could explain it to everyone (both as a picture and as numerical values for the calculated functions), and also justify the choice of a possible critical point for the matching factor.

In fact, the following question arises more generally: Is the existence of a referential stimulus actually a hypothesis (which is proved in the thesis) or is it rather a premise (on which the thesis is built)?

This critical remark is valid only for some of the experiments. It is not valid, for example, for Experiment 2, where changes over time are tracked and direct comparisons of numerical values are sufficient. In Experiment 2, the author correctly makes the caveat that statistical significance was not established. Such is not necessary, because the purpose of the research is not to draw conclusions in the specific subject area, but to demonstrate the capabilities of the method. This goal has been accomplished.

***Summarizing, the thesis presents the results of a huge volume of work, the tasks of presenting and validating the cSM tool have been successfully completed.***

## 5. Evaluation of scientific and practical results and contributions

The contributions of the dissertation work are presented on pages 183-190. I would recommend though that they be brought out even more summarily, within just a few lines.

### **Theoretical in terms of the psychophysical concepts:**

*The relationships between theoretical concepts from psychophysics such as 'internal criterion', 'reference stimulus' and others have been expanded and supplemented.* Indeed, considerable theoretical contributions have been made in this regard. I have a critical remark about the categorical claim (p.183) that the existence of a reference stimulus has been proven. This note is explained in detail in the previous section.

*Added new theoretical concepts related to the cSM method, such as 'coincidence factor', different types of idiographic distributions (clustering or diffuse), etc. and the conceptual connections between them and other psychophysical concepts are defined.* Indeed, the contribution in this regard is significant.

*A theoretical logical paradox related to some conflicting choices in humans has been overcome.* Yes, this is done by adding a presumption of probabilistic nature of human choice. This presumption is correctly and fully defined quantitatively in the algorithms of the method.

### **Methodological:**

*An innovative method in psychophysics - cSM - has been developed.* Yes, this is the focus of the entire dissertation and is a major contribution. The method is presented in its entirety and correctly, and it has also been extensively validated.

*Software applications have been developed to use the method.* Yes, and commendably, the software is made available for open use and is accompanied by detailed instructions for installation and use.

*Additional contributions have been found in detection opportunities based on the results of respondents who answered in bad faith. The method also opens up new possibilities for researching people with certain perceptual deficits and young children.* Yes, these capabilities of the method have been demonstrated.

### **Theoretical in terms of our knowledge:**

*New knowledge about the differences between studies on single individuals and averaging over a group of individuals is added.* Yes, the contributions to this important methodological debate are significant and are among the main ones for the doctoral thesis.

*New knowledge was added in the specific areas where the experiments were conducted.* Yes, beyond the validation of the methodological experiment, each of the vast number of experiments conducted also gives us additional knowledge from the specific diverse fields.

On page 191, the author's publications on the subject are presented. They meet fully the requirements for a Ph.D.

Finally, a project financed by FNI in connection with the topic of the thesis is presented.

***The contributions of the dissertation work are valid, proven and sufficient for a doctoral degree.***

#### **6. Critical notes, recommendations and questions related to the dissertation:**

My main recommendation to the candidate is that in the theoretical framework of his subsequent works, he should be more focused on a single topic and reveal other theories and concepts through their connections with this topic.

In addition, when validating your method, he could explain more unambiguously the type of results that would be obtained if the hypotheses were not true (the null hypotheses) (see 4.)

**I have the following question to the candidate: Associative distances between concepts sometimes violate the metric space axioms (eg the association between 'man' and 'horse' is weaker than the sum of the associations between 'man' - 'centaur' and 'centaur' - horse', which is a violation of the triangle inequality axiom). In such examples, it is debatable whether the psychological data can be represented by Euclidean space and whether the principles of Coombs (1964) could be applied accordingly. My question is whether such data are completely beyond the theoretical capabilities of cSM or could the method potentially be adapted to them as well.**

#### **7. Conclusion**

**In conclusion, the presented paper " CAPABILITIES OF THE COMPARATIVE SCAN METHOD (cSM) IN THE ANALYSIS, VISUALIZATION AND PSYCHOLOGICAL INTERPRETATION OF "PREFERENCE CHOICE" EXPERIMENTAL DATA by Ivaylo Georgiev Panov covers, and in some places significantly exceeds, the requirements for a doctoral thesis . I recommend to the esteemed jury and to the Faculty Council of the Faculty of Philosophy to accept the thesis as completed and to do the necessary to award Ivaylo Georgiev Panov the scientific degree PhD.**

29.03.2023r.

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