

STATEMENT

from Prof. Dr. Vasil Nikolov Kolev,
Institute of Neurobiology, Bulgarian Academy of Sciences, scientific specialty
„Psychophysiology“

about "Critical conditions for observing the inverse base-rate effect"

by Yolina Atanasova Petrova

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Psychology, scientific specialty "General Psychology")

In the dissertation, the phenomenon of the inverse base-rate effect (IBRE) is investigated. In the scientific literature, it remains an open question why there is a preference for assigning ambiguous features to less likely (less probable) categories, since adaptive behavior requires an orientation toward more likely (more probable) events. Knowing the answer to such a question is of particularly great theoretical importance, as it would reveal fundamental aspects of human brain functioning, namely (a) how abstract knowledge is organized (concepts) and (2) how it is used (categorization). In this context, the theoretical significance of the dissertation is that it addresses a significant problem in cognitive science that has remained unresolved for a long time. Also, relevant theories proposed so far are tested: (1) rule-based theories according to which conceptual organization and categorization are processed and governed at a higher analytic level, whereby a category is represented by the entire set of defining features and a process of elimination is executed, and (2) association-based theories, according to which a category is determined by the strength of associative links (the strongest associations) so that category choice depends on how associations are encoded, i.e., on the process of learning and specific conditions of the learning process. The more important issue tackled in the dissertation has direct practical significance. It concerns the critical question of why the human abstraction makes categorization decisions that might not be adaptive as being in conflict with the objective probabilistic structure of environmental information. This problem is particularly significant because of its impact on decision-making processes in all types of human activities and social domains, and resolving it can explain seemingly irrational decisions. In summary, the research addressed in the dissertation is scientifically significant in both theoretical and applied contexts.

The major goal of the dissertation is clearly stated in terms of explicit defining open questions. It is adequately supported by presenting existing categorization theories (rule-based and association-based) and related models (e.g., ELMO and EXIT). The planned attempt to distinguish between categorization strategies has led to a strong experimental focus on association-based theories in order to confirm or disprove them. In this direction, the specific goals and related tasks mainly address the role of information encoding and the formation of represented asymmetry for the occurrence of IBRE. They test the significance of the presence of the learning process itself and the conditions of learning for subsequent categorization by manipulating the objective probability of categories (different and equal) and subjective factors (motivational attitude before learning and before test). A further specific aim is to

tease out the subjective factor and, through a probabilistic model simulation, test whether learning is a necessary prerequisite for IBRE. The task of direct experimental testing of the elimination models related to the rule-based theory is also set in order to control and avoid the effect of representational asymmetry induced by learning. The main objective is clearly argued in an extended and well-organized literature review of the significance of the problem, its historical development and clarification of previous theoretical and experimental developments in the field of cognitive sciences. Each particular task is additionally argued in separate sections in order to clarify and support the specific approach used to solve it. In summary, the aims and objectives are correctly and clearly stated and supported by competent justification.

The chosen methodology is adequately oriented to the set of goals and tasks, which are addressed in 6 separate experiments. The methodological approaches include a computer-based setup in which not only motor behavioral choice responses (correct and incorrect) are recorded, but also verbal reports are used for a detailed exploration and understanding of the categorization process. The stimulus material is described with the necessary precision for reliable replication of the experiments and is further illustrated in informative figures. The methods are detailed for each of the 6 experiments. The choice of stimulus material for category formation is properly tailored to avoid effects of subjective attitude related to (a) the familiarity of features and prevalence of their occurrence in the environment, (b) neutrality of the features, (c) the level of prior knowledge of the tested individuals, and (d) the possibility of direct verbalization. The experimental design is well thought out by introducing proper inter-stimulus intervals, accounting for the number of stimulation trials and designing an appropriate structure of training and test sessions. The sample sizes for each experiment ensure statistical power of the analyses. Statistical analyzes are conducted according to the standards for obtaining reliable results. The detailed analyzes of verbal reports provide important additional information. Inclusion and exclusion criteria are valid. The proposed approach to further analyze poor performers is interesting and introduced to provide important complementary findings.

In the dissertation, several lines of relevant contributes can be identified. First, empirical new evidence is provided that is essential to the development of theoretical knowledge and experimentation in cognitive psychology related to categorization processes. It is demonstrated for the first time that the inverse base-rate effect occurs (1) in rule-based learning conditions, where the representational asymmetries of the learned categories are controlled; (2) in pure conditions without learning, which illuminates the role of the learning process and shows that it is not a mandatory prerequisite for category selection; (3) in individuals with poor achievements and efficiency of training, which confirms that the type and quality of learning is not a conditional factor for IBRE; (4) under varying subjective contexts, showing that motivational conditions do not alter the propensity to the inverse base-rate effect; (5) in a general-purpose association-based architecture with no representation modulations/no learning, confirming that learning is not a factor in IBRE. For the first time, it is shown that the inverse base-rate effect does not occur with equal category probabilities, thus showing that asymmetric associations may not be the only source of category selection

choice. Further, the role of asymmetric representations in classification learning is confirmed for the first time through verbal reports. Also, demonstrating that IBRE does not occur with equal category probabilities is an original empirical contribution as it clarifies the role of probabilistic asymmetric associations. The dissertation presents 3 important methodological contributions that are relevant for conducting controlled experiments in future research of the organization of concepts and their categorization. The main scientific contributions consist in (1) providing new evidence about the role of hitherto unknown factors in categorization and (2) confirming the two theoretical models of categorization, which opens up a new promising field for future research.

The dissertation work of Yolina Petrova is based on a total of 3 publications published in international scientific journals and proceedings. Two of them appear in international journals with impact factor and one - in a specialized proceeding of an international conference. The dissertation is written in English on a total of 132 pages, containing supporting figures, tables and an exhaustive amount of cited references, as well as 8 appendices. It is noteworthy that the work is written in elegant English and demonstrates a perfect use of specific terminology, which greatly facilitates the presentation.

Conclusion

The dissertation of Yolina Petrova presents a scientifically important, high-level research with relevant research goals, adequate methodology, and contributions to theoretical and methodological developments in the field human categorization processes. The presentation of the material is concise and accurate and above all, the doctoral student demonstrates solid theoretical knowledge and faculties and skills in experimentation. The relevance and success of the PhD work are beyond doubt, and the dissertation itself opens up new perspectives for future scientific research. All this gives me a reason to confidently recommend to the esteemed members of the jury to award Yolina Petrova the educational and scientific degree "doctor".

15.08.2023, Sofia



/Prof. Vasil Kolev/