Journal of Consulting and Clinical Psychology
1984, Vol. 52, No. 4, 705–707

Stimulus Variables in the Block Design Task Revisited: A Reply to Royer

Ralph J. Kiernan, Gordon H. Bower, and Dennis Schorr
Stanford University

Royer (1984) criticizes our analysis of the Block Design Test (Schorr, Bower, & Kiernan, 1982) more for form than substance. We prefer an interpretation in terms of individual difference variables rather than stimulus characteristics. In addition, Royer's variables do not appear to have the general application that he claims for them.

Royer (1984) has written an extended commentary of our recent article (Schorr, Bower, & Kiernan, 1982). The series of experiments described in our article investigated the important stimulus variables in block design construction tasks. He points out correctly the essential agreement between our results and his own (Royer, 1977; Royer & Weitzel, 1977), but he criticizes our article on two points: (a) the general issue of the quantification of stimulus variables and (b) the issue of analytic versus synthetic strategies in the block design task.

After describing his five-step model of the block design task, he focuses on two variables, task uncertainty and perceptual cohesiveness. Task uncertainty is "a measure of decisions imposed by block-face alternatives" (Royer, 1984, p. 700). It is equal to twice the number of blocks minus the number of solid blocks needed to construct a given design. Perceptual cohesiveness reflects the amount of mental segmenting that must be done. It is equal to "the number of block edges of the same color that are adjacent to one another in the construction" (Royer, 1984, p. 701).

Royer (1984) states that we (Schorr, Bower, & Kiernan, 1982) renamed these variables without explanation. Our studies were completed during the winter and spring of 1977 and written initially as an honors undergraduate project (Schorr, 1977, June). The Royer articles (Royer, 1977; Royer & Weitzel, 1977) appeared while we were rewriting the manuscript, and the problem of how best to reference and include these presented itself. The stimulus names he used were embedded in a perceptual model (Garner, 1962) unfamiliar to us. In addition, the model placed primary emphasis on the stimulus rather than the subject, a direction opposed to our own. We chose to keep variable names that were close to the data and atheoretical, namely, *number of solid blocks* and *number of edge cues*.

The "edge cues" that we described (Schorr, Bower, & Kiernan, 1982) are essentially identical to the adjacency count that Royer makes (Royer & Weitzel, 1977). There is no way to contrast these variables, and there is no doubt that Royer's labeling has priority. When we said that edge cues have received only scattered citations in the literature, we did not mean to disparage Royer's studies. They are important, well-done studies. However, the point is that in the 60-year history of an important, widely used, and widely researched test, this variable, surprisingly, has been addressed only a few times.

Royer (1984) further asserts that we failed to satisfy the three requirements of "the metricization of a stimulus" (p. 701). His first requirement is that the measure be conceptually relevant to the presumed psychological processes. Here he seems to mean that the name given to a stimulus should sound as if it explains some psychological process. We felt that the stimulus name should be descriptive of what is actually varied rather than something conceptual and only inferentially related to the variable. Certainly, both his measures and ours are relevant to the psychological processes, as the data clearly show.

His second requirement is that the measure "increase as the performance measure increases" (p. 701). This seems purely arbitrary, implying that there is something inferior about a measure that is inversely related to performance.

His third requirement is more important. A variable that ranges "across the entire task space" (i.e., designs of 4, 9, 16, 25 blocks) would be superior to one that simply deals with a restricted range of problems. Royer's variable, task uncertainty (TU), is equal to twice the number of blocks minus the number of solid blocks. His variable obviously refers to number of blocks, whereas ours does not. There is no question that the number of blocks required

Dennis Schorr is presently a graduate student at Yale University.

Requests for reprints should be sent to Ralph J. Kiernan, who is now at the Santa Clara County Mental Health Acute Services, Dr. Don Lowe Pavilion, Residential Psychiatric Facility, 2277 Enborg Lane, San Jose, California 95128.

to complete the construction is an important factor predicting the time needed for correct performance. It is obvious that 9-block designs, for example, take longer than 4-block designs. The important question is whether this variable is more clearly expressed as part of task uncertainty or as itself, the number of blocks. There is little to justify the uncertainty variable in Royer's own data.

In the first article (Royer & Weitzel, 1977), only 16-block constructions were studied, so that an effect of number of solid blocks was seen, but no comparison of the effect of number of blocks can be made. That is, the alleged "range across the entire task space" (Royer, 1984, p. 701) of task uncertainty factor was not investigated.

In a second article, Royer (1977) constructed block designs analogous to the dot matrices from Garner and Clement (1963), which exhibited different sizes of "equivalence sets" (p. 35). This method of stimulus selection produced an unsystematic variation in his task-uncertainty variable. The full range of task uncertainty values was not sampled and many points were overrepresented. For example, 9 of the 26 designs studied had a TU of 9, whereas only one design had a TU of 5, and two had a TU of 6. No designs were included at the intermediate TU steps of 7, 10, 11, 12, 14, 15, 16, or 17, although all were possible. In addition, the designs studied confounded TU with perceptual cohesiveness ("adjacencies") in such a manner as to preclude interpretation of the results. It seems likely that some of the effect Royer attributed to TU could be accounted for by the cohesiveness of the designs.

Although construction time increased with task uncertainty, it could hardly fail significance, because TU is largely a function of the number of blocks to be placed in the construction. We have independently analyzed crucial transition points between 4-, 9-, and 16-block designs having equal adjacency counts. For example, in Royer and Weitzel (1977), the two mixed 16-block designs with a TU of 24 and an adjacency count of 12 were constructed in 47.8 s on average in the uncued condition. In contrast to this performance, the diagonally arranged 9-block design with a TU of 18 and an adjacency count of 12 in Royer (1977) required 64.16 s in the uncued condition. Thus, at a fixed adjacency count, the performance was not predicted by task uncertainty. To take another comparison from Royer (1977), the construction time for the diagonal 4-block design with a TU of 8 and an adjacency count of 3 was 21.20 s. This was slower than any of the times for the solid 9-block designs having a TU of 9, regardless of the adjacency count. The results at these transition points contradict the claim that task uncertainty ranges predictively across all design sizes.

The second criticism involves our discussion of analytic and synthetic strategies (Schorr, Bower, & Kiernan, 1982). Royer (1984) correctly points out that the only direct support for the existence of a synthetic strategy in our data was in Experiment 1. Our evidence, however, does not rest on one data point but on a significant interaction between six data points (two slopes of opposite directions). Because this effect was predicted, it seems unfair for Royer to refer to it as "aberrant" (Royer, 1984). Contrary to Royer's implication, our Experiment 2 was not designed to replicate the first experiment, but to study how subjects decided whether a piece was bicolored or solid. Nevertheless, the significant interaction between type of block and number of interior edges was consistent with our Experiment 1. Our evidence for a synthetic strategy in Experiments 1 and 2 came from the identification of solid blocks, and it is not surprising that we did not obtain evidence for a synthetic approach in Experiment 3. Again, Royer seems to ignore the distinction between solid and bicolored pieces because it is not predicted by his model. In the article (Schorr, Bower, & Kiernan, 1982) we adequately discussed the lack of evidence for a synthetic strategy in Experiment 3.

It is clear from both of Royer's studies (Royer, 1977; Royer & Weitzel, 1977) and our own (Schorr, Bower, & Kiernan, 1982) that the average college student (who has substantially above average block construction ability, as judged by the times for 9-block constructions) consistently follows an analytic approach to the construction task. The adjacency count or number of interior edge cues predicts reliably the time to complete the construction. With these subjects, it does not matter whether one focuses on the stimulus characteristics or the hypothesized strategy. It does matter, however, when one studies less competent performers.

Preliminary data on young children (Kiernan, 1979), patients with lateralized brain infarction (Kiernan & Schneider, 1983), and older normal subjects (Schneider, 1980) show more use of synthetic strategies, because there is a complete breakdown in the orderly relationship between interior edge cues and performance. Such individuals can utilize the edge cues when these completely specify each cell, but they have difficulty doing the mental segmenting required by designs in which some of the edge cues are not present. They can, however, obtain better performance times on designs having no edge cues by presumably using a pattern-matching strategy. It was our interest in studying these groups of less efficient block construction performers that led us to focus on strategies rather than on stimulus-design characteristics only. We believe that this orientation provided a natural avenue for studying these other subject groups.

References

Garner, W. R. (1962). *Uncertainty and structure as psychological concepts.* New York: Wiley.

Garner, W. R., & Clement, D. E. (1963). Goodness of pattern and pattern uncertainty. *Journal of Verbal Learning and Verbal Behavior, 2,* 446–452.

Kiernan, R. J. (1979, February). *The development of block design ability in first and second grade children.* Paper presented at the Seventh Annual Meeting of the International Neuropsychology Society, New York. (Available from R. J. Kiernan, Santa Clara County Mental Health Acute Services, Dr. Don Lowe Pavilion, Residential Psychiatric Facility, 2277 Enborg Lane, San Jose, CA 95128.)

Kiernan, R. J., & Schneider, J. A. (1983, August). *Lateralized brain lesions and cognitive strategies in block design tests.* Paper presented at the Ninety-First Annual Meeting of the American Psychological Association, Anaheim, CA. (Available from R. J. Kiernan, Santa Clara County Mental Health Acute Services, Dr. Don Lowe Pavilion, Residential Psychiatric Facility, 2277 Enborg Lane, San Jose, CA 95128.)

Royer, F. L. (1977). Information processing in the block design task. *Intelligence, 1,* 32–50.

Royer, F. L. (1984). Stimulus variables in the block design task: A commentary on Schorr, Bower, and Kiernan. *Journal of Consulting and Clinical Psychology, 52,* 700–704.

Royer, F. L., & Weitzel, K. (1977). Effect of perceptual cohesiveness of pattern in the block design task. *Perception & Psychophysics, 21,* 39–46.

Schneider, J. A. (1980). *Effects of age on cognitive processes involved in spatial tasks.* Unpublished doctoral dissertation, The California School of Professional Psychology, Berkeley.

Schorr, D. (1977, June). *Analysis versus synthesis in a task of spatial abilities: An information processing analysis of the Kohs-WAIS block design test and some implications for clinical diagnosis and rehabilitation of brain damaged individuals.* Senior honors thesis, Stanford University.

Schorr, D., Bower, G. H., & Kiernan, R. J. (1982). Stimulus variables in the block design task. *Journal of Consulting and Clinical Psychology, 50,* 479–487.

Received July 5, 1983
Revision received February 22, 1984 ■