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A Reply to Kranzler and Weng's Shooting in the Dark

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In this short article we examine a proposed revision of the PASS theory suggested by Kranzler and Weng (this issue) following their analysis of a study we conducted some years ago. On the basis of LISREL analyses of a small sample of students, Kranzler and Weng have suggested a revision in the planning, attention, simultaneous, successive (PASS) cognitive processing model. We developed this model from the neuropsychological work of A. R. Luria and from cognitive psychological findings that have been published over the past 40 years. Kranzler and Weng's suggestion is that planning and attention are not distinct enough to warrant separation and the model should be changed to (PA)SS. We firmly and completely reject this suggestion because (a) they use a factorial approach to theory building that we reject; (b) their suggestion is based on one factor analysis of a relatively small sample based on some tests that have since been modified or rejected; (c) they ignore the large volume of evidence from neuroscience and cognitive psychology that attentional and planning processes are separate cognitive functions; (d) more recent confirmatory research supports the separation of planning and attention; and (e) they provide insufficient evidence to make such a modification.

Keywords: PASS; Cognitive processing; Intelligence.

INTRODUCTION

The Kranzler and Weng article provides an excellent example of how competent professionals in the field of psychology can lose their way because their focus is more on factor analysis than on a firm theoretical basis for making important decisions about the structure of human intelligence. Their mistake was to base the decision that PASS should be (PA)SS on one factor analysis of a small sample of students while using an experimental version of tasks that we were using some 5 years ago and that is composed of tests we have since eliminated from the current version of the Das-Naglieri Cognitive Assessment

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System standardization test battery. Because of page limitations we will address only some of the weakness and problems involving their interpretation of their reanalysis of the very first LISREL article we published (Naglieri, Das, Stevens, & Ledbetter, 1991). We have organized this article into two sections; the first deals with factor analysis issues and the second involves experimental design and general test development considerations.

FACTOR ANALYSIS

The Wisdom of Spearman's *g*

That individuals vary in general intelligence and rivers have a general depth are not controversial statements. We have in our midst intellectual giants as well as individuals with mental handicaps. Anyone who has lived on the banks of the Ganges, knows that it is generally a deep river, but it is when crossing from a village on one side to the other side of the Ganges that the specific depth of the river at that point becomes enormously important. Knowing an individual's general intelligence is not very useful when we attempt to understand the reading disability of intelligent dyslexics, or find that among the mentally handicapped, characteristic differences in cognitive processes exist. Then we are compelled to examine that which lies beyond general intelligence.

The article by Kranzler and Weng puts emphasis on the concept of general intelligence, and the authors argue that they have "discovered" a substantial *g* among our PASS tests. Anyone who has used psychometric tests of abilities, or has observed the intellectual performance of many individuals, cannot be surprised by the discovery. Spearman, having "discovered" *g*, failed to prove the existence of a general factor alone because specific factors also appeared in his factor analysis. Some of the variance of each test remained unexplained. Das, Kirby, and Jarman (1979) noted that "disagreements about the nature of that specific variance were to characterize the psychological study of intelligence for a long time . . . [and] rival techniques of factor analysis were developed that tended to produce a large number of factors" (p. 5).

We have suggested the four major cognitive processes of planning, attention, simultaneous, and successive (PASS) that are derived from neuropsychological and cognitive data bases. The efficacy of the model is continuously being demonstrated in empirical studies with both intellectually normal and handicapped individuals (see Das, Naglieri, & Kirby, 1994) by means of many types of experimental designs and statistical procedures, including multivariate techniques. In our research, factor analysis has been used as only one of the sources of support, because we agree with Guttman and Levy (1991) that factor analysis as a statistical tool is not suitable for discovering mental structures.

Kranzler and Weng miss the point when they use factor analysis to revise

PASS. You can not prove or disprove a theory by factor analysis—you can only provide, or fail to provide, *a particular type* of support for it. Notwithstanding this point, PASS is a theory that is related to Luria's view of brain functioning based on neuroscience, and it therefore cannot be changed by factor analyses. Factor analysis is useful only for examining the extent to which tasks developed according to the theory can effectively be used to operationalize the constructs—that is, to determine if the tests developed appear to have sufficiently isolated the processes of interest so that effective calibration of a person's competence can be made within each of the PASS areas.

What are the objections of Kranzler and Weng and the empirical evidence in favor of the four major cognitive processes? Kranzler and Weng argue that at least two of the "alternative models" of intelligence tested by Naglieri et al. (1991) are *not very traditional*. These models are Spearman's *g*, and the division of intellectual abilities into memory versus reasoning. Naglieri et al. (1991) used these two models along with verbal-nonverbal dichotomy of abilities and visual-spatial-speed categories of abilities as competing models for testing the best possible fit by using LISREL. It is indeed surprising to read that Kranzler and Weng consider the first two models *not very traditional*. If the concept of general intelligence and dividing mental abilities into the two prominent categories of memory versus reasoning are not traditional, then Kranzler and Weng must assign a very different connotation to the word *traditional*. They state that the relatively poor fit to the data provided by the *g* and the memory-versus-reasoning models, as found in Naglieri et al., is not unexpected. Whatever may be their connotative sense of the word *traditional*, we completely agree that the poor fit is real and not unexpected—we did not expect *g* or memory-versus-reasoning models to be supported.

In and Out of the Web of Factor Analyses

Our position is that *theory* does not flow out of the tables of factor analyses. The more salient conclusions Kranzler and Weng derived from their reconstruction of Naglieri et al. (1991) factor analyses are included in their Table 3. It shows *no difference* between PASS and the alternatives proposed by Kranzler and Weng. Kranzler and Weng acknowledge this: Notwithstanding the apparent superior fit of the (PA)SS model, the chi-square difference between it and the original PASS model was not significant . . . nor was the PASS + *g* hierarchical model. *Should one therefore reject the PASS model on the basis of the absence of difference?* The answer can be in the affirmative only if we have a theoretical justification for doing so. As the discussion of empirical studies based on separate measurement of P and A will show, there is compelling evidence to retain the distinction between P and A.

Next we try to get out of the justification provided by the web of hierarchical factor analysis. Remember that we never disown the presence of *g*, it being similar to the general depth of the Ganges. Table 4 in Kranzler and Weng

represents the four PASS factors and "interfactor correlations." Instead of Table 4, Kranzler and Weng should have presented a table of hierarchical factor resolution with second-order factor(s) and orthogonalization of P, A, S, and S. Did they obtain only one *g* or two, as Das and Dash (1983) did? And did they then proceed to a third-order factoring to give, as it must, one *g*? If they were not satisfied with the results, then there might be a justification for doing a hierarchical factoring on the regrouped tests, combining P and A, S, and S. Until these data are presented, their results in Tables 4 and 5 are inconclusive.

Finally, how do we understand the original Naglieri et al. (1991) figure and the revised figure of Kranzler and Weng? Let us first understand that these figures are not critical for the decision regarding acceptance of PASS or its so-called alternatives; Kranzler and Weng would agree that we should regard their Tables 1, 2, and 3 as providing the critical evidence for the alternatives. However, from Kranzler and Weng's remarks regarding the "correlation" values between the PASS factors, it seems that their reason for doubting the independence of P and A rests on "correlation" of 1.00 (Naglieri et al., 1991, Fig. 1) and 1.06 in their reconstructed figure. First of all, in the special sense of "correlations" in LISREL, it is legitimate to obtain values greater than unity. Second, the correlation between the Attention and Simultaneous factors in both figures remains high (.90). Following Kranzler and Weng's logic, then, does it provide a justification for reconstructing a new model, P + A + S and S? And if it does, it may not differ significantly from P + A, S, and S as their reconstructed model. We must reiterate that the primary role of theory is in directing factor analyses as well as empirical studies.

Incidentally, there is a factor error when Kranzler and Weng quote Das (1992), stating that omitting measurement of the planning and attention functional units results in the ranking of individuals on a unidimensional scale of merit. Das did not single out planning and attention; all four processes were mentioned to demonstrate that a unidimensional scale of merit could have an alternative.

EXPERIMENTAL DESIGN AND TEST BUILDING

The Principle of Parsimony and Building a Test From Theory

Kranzler and Weng suggest that because there was not a significant difference between the PASS and PASS + *g* models, the most parsimonious model, which is the latter of the two, was accepted. This is based on the degrees of freedom (*df*) of the PASS ($df = 29$) and PASS + *g* ($df = 31$) models. Choosing the model with the higher *df* was used to make the selection on the basis of the lack of a clear winner in the comparison of the two models. But the principle of parsimony is that the simplest of two hypotheses should be

accepted, *all else equal*. It does not negate the acceptance of complex explanations if the data require such (Marx & Hillix, 1963, p. 391, emphasis added). Kranzler and Weng fail to recognize that the comparison is *not equal*. Moreover, the results of their reanalysis of a single factorial study involving 132 students does not contradict the huge amount of neuropsychological (Luria, 1966, 1969, 1970, 1973, 1980, 1984) and experimental evidence on the theory of human cognitive functioning we call PASS (see Naglieri & Das, 1990, Naglieri, Das, & Jarman, 1990, or Das et al., 1994, for summaries of the validity of the model). Thus, Kranzler and Weng's statement that the "(PA)SS model also has the added theoretical advantage that it is more parsimonious than the original PASS model" *is wrong*. There is no contest, when comparing PASS with (PA)SS or PASS + *g* because all else is not equal. *Theory* tells us that PASS is best because it comes from the neuropsychological model, and the evidence that has been published for more than 25 years is too compelling to consider the revision they suggest.

Empirical Studies of Planning and Attention

Kranzler and Weng suggest in their conclusion that the refinement of PASS theory or tests, or perhaps both, is necessary because of their discovery of a substantial *g* among the PASS tests and their failure to separate planning from attention. We agree that a theory should be constantly revised, updated, and perhaps eventually superseded; but one factor analysis does not make a theory. Let us first concentrate on the theoretical relationship between planning and attention.

We have written elsewhere (Das, 1992; Das & Varnhagen, 1986; Naglieri & Das, 1988; Naglieri, Das, & Jarman, 1990) that the relationship between planning and attention is complex. The complexity arises out of the neuropsychological nature of the two processes as we have discussed in these articles. We have shown through empirical research that it is useful to consider the two processes as separate and distinct from each other. For example, individuals with phonological coding problems have planning not attention problems (Naglieri & Reardon, 1992) and planning can affect performance on Progressive Matrices (Cormier, Carlson, & Das, 1990). In the latter example, problems from the Coloured Progressive Matrices were administered to children divided as good and poor planners on Visual Search, a test of planning, before and after an intervening period of verbalization. Although both groups of children gained after verbalization, the gain was substantially greater for the poor planners. These results were replicated in a more recent study by Kar, Dash, Das, and Carlson (1993) and Naglieri and Gottling (1994) and indicate that planning, not attention, played a significant role in the design of intervention programs. Therefore, we cannot accept Kranzler and Weng's suggestion of combining planning and attention; we doubt that much theoreti-

cal clarity would occur if we did not consider planning as a distinct component of processing. Additionally, we are certain that such a combination would diminish the utility and validity of the PASS theory.

Using Old Experimental Tasks

Kranzler and Weng's reanalysis of the first confirmatory factor analysis study we conducted is based on many experimental tasks that have since been revised considerably (e.g., Selective Attention–Receptive) or discarded completely (e.g., Design Construction). The data we used to conduct our factor analyses were obtained at a point when we had first operationalized the Attention scale. The Selective Attention–Receptive test we used then has been changed in important ways as part of our continuing efforts to effectively isolate attentional processes and reduce the influence of other processes. We never expected all the tasks to be pure measures of the processes we anticipated on the first try.

Processing tests are very sensitive to small variations in the structure of the task, and therefore fine tuning of the measures has been conducted. For example, we found that the Selective Attention–Receptive Letters test format used in the Naglieri et al. (1991) study allowed for the use of a strategy, and therefore planning processes affected the score on a test designed to measure attention. The test required the child to find letter pairs that look the same (e.g., RR or ee not Re or Eb). In the early version of the test the first letter of the pair always appeared in upper case and the second letter was in upper or lower case. The students reported that they simply ignored any letter pair that did not have the same case. This allowed them to complete the task more effectively—a good strategy—making the task correlate with other planning tests. In this case our construction of the task was imperfect, and the result was a test that was not a very pure measure of attention like the ones we have since developed and incorporated into the Das-Naglieri: Cognitive Assessment System Standardization Edition (DN:CAS) (Das & Naglieri, 1993). Thus, any results that use early experimental versions have to be placed in their proper perspective. Kranzler and Weng's use of this test, therefore, does not inform us about how to modify the PASS theory, but rather, how to further refine the tests used to operationalize the constructs. The success of the modifications was apparent in recent evidence on the factorial validity of the PASS model.

More Recent Research

Since the Naglieri et al. (1991) study was conducted we have examined the PASS model by the confirmatory technique in a recent publication. Naglieri, Braden, and Gottling (1993) found that the PASS model was supported over *g*, orthogonal four-factor PASS, and correlated three factor where P and A

were combined into one factor. In that study we also found that the data deviated significantly from values predicted by a hierarchical model, although the correlated four-factor PASS model did not differ significantly from it. In view of the fact that the four-factor PASS model had fewer components than the hierarchical PASS model, the latter hierarchical model was rejected on the basis of the fit of the findings to the theory, as it should be if the principle of parsimony is used. This investigation suggests that Kranzler and Weng should have been more tentative in their conclusions and paid more attention to their own statement that "cross-validation of their results is required before firm conclusions regarding the latent structure of the PASS tests can be made." At least as far as the results of the Naglieri et al. (1993) study suggest, the Kranzler and Weng results do not appear to be reproducible. Unfortunately, Kranzler and Weng did not follow their own advice, and instead made the suggestion that a revised (PA)SS model should replace the theoretical view we call PASS. We firmly reject their arguments, which are based on too few data and experimental tasks that have since been changed or deleted.

Testing Models or Clouding the Issues?

One important responsibility we have as members of the scientific community is to facilitate the growth of knowledge through good science. The article by Kranzler and Weng is an attempt to evaluate initial efforts we made to operationalize a new theory of human competence. Our PASS theory is designed to go beyond traditional tests and the psychometrically based view of *g* to provide a strong multidimensional theoretical view of intelligence. The goal of PASS is to facilitate a modern view of intelligence conceptualized within the framework of cognitive processes, and the article by Kranzler and Weng is an attempt to scrutinize our efforts. Our work should be carefully examined by the scientific community and this should be done in accordance with the highest scientific standards.

The criticisms by Kranzler and Weng miss the point of our work, however, and their conclusions do not recognize the need for careful consideration of the limitations of their study. For example, because Kranzler and Weng did not recognize the limits of the generalizability of their findings, they did not adequately limit their conclusions. Because the results of their reanalysis were based on tasks we no longer use in the DN:CAS, it would have no generalizability beyond the original data unless we retained the same outdated experimental tasks. Moreover, their analysis of imperfect experimental tasks intended to operationalize a theory does not generalize to the theory, but only those specific efforts to operationalize it. Their criticisms, therefore, are not generalizable to the PASS theory and do not facilitate growth of knowledge through scientific inquiry, but rather, provide weak conclusions that obscure the issues.

Going Too Far With Too Few Data

Kranzler and Weng have departed from good science when they make statements such as "Inclusion of the present battery of planning and attention tests in Das and Naglieri's new measure of mental ability (the Cognitive Assessment System) is suspect." First, Kranzler and Weng have no information on the current form of the Das-Naglieri: Cognitive Assessment System Standardization Edition (DN:CAS) (Das & Naglieri, 1993). They have not recognized that the tasks we used in our first confirmatory study are not the same ones we are using in the standardization edition of the DN:CAS. They have no authority to write on the validity of our new scale nor to suggest that our test, which has not even been published, is flawed. Making these statements about our forthcoming new scale on the basis of a reanalysis of out-of-date experimental forms of PASS is inexcusable!

Missing the Big Picture

It is important to keep in mind that *g* and its representation in traditional IQ tests has been under considerable attack for being irrelevant to learning disabilities (e.g., Siegel, 1989), ineffective for the design of interventions and differential diagnosis (Kavale & Forness, 1984), insufficient for conceptualization of intelligence (Das, 1992), and too narrow in scope to adequately describe human ability (Naglieri & Das, 1990). Authors who overgeneralize from one small study involving experimental tasks no longer used miss the point. Psychological assessment, described by Anastasi (1988) as one of the most important contributions of applied psychology, has to move beyond traditional views of general intelligence if the utility of intelligence tests is to be improved for diagnosis as well as intervention design (for more on this topic see Das, 1992, and Das et al., 1994). The article by Kranzler and Weng distracts us from the recognition that intelligence tests need to be modernized and *based on a sound theory*. We must look ahead to move the field forward so that recent criticisms can be adequately addressed.

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