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Separating Planning and Attention

Evidential and Consequential Validity

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Abstract: In this article the authors present several justifications in favor of the position that the constructs of planning and attention as described in the planning, attention, simultaneous, and successive (PASS) theory of information processing are separate but interdependent processes. There are two parts to the article. The first part comprises a discussion of issues on the need for separating planning and attention and provides evidential validity by reviewing some selected studies. The second part reexamines a factor-analytic study that has questioned the separation of planning and attention processes. The reexamination showed a negligible statistical difference between the proposed three-factor model and the previously established four-factor model. Because the evidential validity of the four-factor model seems reasonably strong, the authors conclude by suggesting that there is little reason to choose the three-factor model that combines attention with planning.

Résumé: Dans cette article les chercheurs présentent plusieurs justifications en faveur de la position dont les construits de planification et attention comme décrit dans la planification, attention, simultané et successif (PASS) théorie du processus d'information sont séparés mais sont des processus indépendant. Cette article se compose de deux articles. La première partie contient une discussion de sujets sur le besoin de séparer la planification et l'attention et fournit la validité probante en révisant quelques études sélectionnées. La deuxième partie réexamine une étude de facteur analytique qui questionne la séparation du Processus de la Planification et de l'Attention. Le réexamen indique une différence négligeable statistique entre les modèles de trois facteurs et les modèles de quatre facteurs établis précédemment. Comme la validité probante des modèles de quatre facteurs semble fort, les chercheurs concluent en suggérant qu'il y a peu de raison de choisir les modèles de trois facteurs qui combinent l'attention avec la planification.

Keywords: *cognitive assessment; planning; attention; PASS*

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The central theme of the present article concerns the relative independence of the constructs of planning and attention and the evidence collected from school-children that favors the separation between these two constructs. There are two parts to this article: The first part deals with a discussion of issues on the need for separating planning and attention and reviews some selected studies; in the second part, the data are reexamined from a factor-analytic study that questions the separation of planning and attention processes. Specifically, the authors address the argument recently advanced by Kranzler, Keith, and Flanagan (2000), which essentially faults the Das-Naglieri Cognitive Assessment System (CAS; Naglieri & Das, 1997) as being unrepresentative of the four cognitive constructs of planning, attention, simultaneous, and successive processing. In the present article, the authors question their argument, which is entirely based on confirmatory factor analysis of data collected from a small sample. Essentially, the key focus of Kranzler et al. is to treat planning and attention as a variation of speed. In the present article, the authors discuss the separation of planning and attention from mostly a non-factor-analytic point of view, considering the nature of the constructs and their evidential and consequential validations.

Part I: On Validating the Constructs of Planning and Attention

Messick (1989) is widely quoted as a guide for establishing validity of tests and presumably the constructs that give rise to a test's validity. He described validity as "an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of inferences and actions based on test scores" (p. 13). Statistical procedures, including factor analysis, are one form of "empirical evidence," although a theoretical rationale must pre-exist the statistical maneuvers of which the essential purpose is to provide evidence for the theory. In other words, the theoretical rationale cannot be an afterthought. Furthermore, the evidence need not be based only on correlations between tests. Das, Naglieri, and Kirby (1994) made the same point, and Naglieri (1999) again reiterated that a range of evidence is required to establish construct validity. Factor analysis may be only one piece of evidence, or it may not even be deemed necessary for the validation of constructs of intelligence, such as Sternberg's (1985) triarchic constructs of intelligence and Gardner's (1983) multiple intelligences.

Bare Essentials of Planning and Attention Constructs and Testing Their Validity

Planning processes are required when an individual makes decisions such as how to solve a problem, carry out an activity, or compose a narrative. It involves goal setting and within it, anticipating and monitoring feedback. Planning comprises the

programming, regulation, and verification of behavior (Luria, 1966). An individual adopts a set of decisions and strategies and modifies these while solving a problem and planning. Planning processes are closely connected with attention on one hand and with simultaneous and successive processing on the other. In assessing an individual's information processes, planning processes are needed when a test requires that the individual makes decisions about how to solve a problem; executes an approach; activates attentional, simultaneous, and successive processes; monitors the effectiveness of the approach; and modifies the approach as needed. Instead of being a hierarchical and linear process, planning is often nonlinear and revisionary in nature, and the formation and execution of a plan can occur simultaneously (Das, Kar, & Parrila, 1996).

The planning tasks in the CAS require strategies, which are coded from the examiner's observations and verbalizations of the individual child. Naglieri (1999) argued tirelessly in regard to the importance of observing strategies as well as the manipulation of strategies as a variable in experiments on planning. Naglieri and Das (1997) provided ample evidence that the vast majority of children use strategies to complete the planning tests included on their CAS (several more experiments are reported in the book by Das et al., 1996). The authors suggested that "Planning would not be possible without some semiotic mediation that enables both the self-regulation and the restructuring of the decision-making process" (p. 111).

Attention is a mental process by which a person selectively registers some stimuli and ignores others. It is a cognitive activity as human beings interpret arousal in terms of their ideas and thoughts. Attention has at least two primary aspects: It can be focused, and it is selective. In both focusing attention and selecting relevant information from irrelevant information, an individual must resist distraction. Posner and Boies's (1971) classic work identified three major components of attention, which are alertness, selectivity, and processing capacity. The component of alertness is most easily understood in terms of arousal. The selectivity aspect of attention relates to intentional discrimination between stimuli. For example, in the CAS's Receptive Attention subtest, name-match versus physical-match letter test, selective attention is tested when participants are required to detect letter pairs that are physically identical or are identical by name (e.g., BB, bB). In a related study, the relationship between the teachers' ratings of children's attentional behavior in the classroom and those children's performances on the CAS tests of Expressive and Receptive Attention was examined (Das, Snyder, & Mishra, 1992). It was clear that teachers' ratings of attention in the classroom correlated with performance on the two CAS tasks that require selectivity and resistance to distraction.

In short, it is argued that the basic attention processes, both at the level of cognition and the brain, can be separated from planning or executive functions (Luria, 1966). Luria's (1966) work suggested the importance of treating attention separately from planning, which includes executive functions, judgments, decision making, and evaluations. In the following section, the authors discuss some empirical studies as corroborating evidence to establish the relative independence of planning and attention constructs.

Reviews of Past Studies

A study of attention deficit hyperactivity disorder (ADHD) and planning. The ADHD child's key difficulty is not inattention or poor attention; rather, it is the failure to stop, look, listen, and feel. A deficiency in the child's ability to inhibit behavior is implicated, characterizing a failure of executive functions (or planning as in the PASS theory). Consistent with this line of conceptualization of ADHD, Barkley (1997) attempted at solidifying ADHD explanations in terms of dysfunction of the frontal lobe. It has for its centerpiece the concept of behavioral inhibition, of which children with ADHD seem to have an extremely low level.

We suggest that behavioral inhibition of children with ADHD while explained as a cognitive deficit is a variant of planning processes (Das et al., 1994). Planning function is organized in the frontal lobe, and the major brain area that differentiates ADHD and "normal" children is the frontal lobe, whose size is smaller and activities are decreased in children with ADHD (Panskeep, 1998). Cortical underarousal or diminished activation of the front part of the brain has been suspected among children with ADHD, who are found to have low metabolic activity in their frontal lobes. As we accept this explanation and the location of the cognitive difficulties of ADHD, the logical next step is to present some empirical results using the CAS with the intention to single out planning measures as particularly relevant.

A recent study by Naglieri, Goldstein, Iseman, and Schwebach (2003) is mentioned as an example of evidential validity. The part of the study that is relevant here concerns the comparison between a sample of 25 children with ADHD and a normative group on two tests, the CAS and the Wechsler Intelligence Scale for Children-III (WISC-III). The purpose was to examine the assumption that the PASS theory and its derivative, the CAS, may be particularly sensitive to the cognitive difficulties of children with ADHD, whereas the general intelligence test, the WISC-III, is inadequate for diagnosis of ADHD. Specifically, a low planning score was expected for the ADHD sample. The results showed a large effect size for planning between the ADHD and the standardization samples. However, in regard to the Attention Scale, a small effect size was observed. The differences between the two samples in the Simultaneous and Successive Scales were not significant. Incidentally, in regard to the WISC-III, the only difference that had a significant but small effect size was found in processing speed when ADHD and the normative samples were compared.

Planning deficit predominant in fetal alcohol syndrome. The difference between planning and attention is again found to be meaningful in research on fetal alcohol syndrome (FAS) as suggested in a recently completed study (Mackey, English, Bisanz, & Kulak, 2003), which is briefly reported. Its purpose was to determine whether planning (Mackey et al., 2003, regarded executive function, EF, as equivalent to planning) was a relative weakness in the FAS population.

The participants included 7 children diagnosed with FAS (5 boys and 2 girls) and 11 children with confirmed prenatal exposure to alcohol who did not have the physical characteristics required for an FAS diagnosis (7 boys and 4 girls). The children were of aboriginal descent. The mean age of the FAS group (in years:months) was 10:7 ($R = 7:9$ to 13:4). The mean age of the group with alcohol-related effects other than FAS was 9:4 months ($R = 6:1$ to 12:8). The mean Full Scale standard score of the sample was 84.6, and the standard deviation was 13.2.

To determine whether the four PASS scores differed, a repeated measures ANOVA was performed. The analysis indicated an effect of PASS components, $F(3, 57) = 11.12$, $p < .001$. Importantly, tests of simple effects showed that the mean planning score was lower than the mean for the other components ($p < .001$). Furthermore, the mean simultaneous processing score was higher than the mean of the attention and successive processing scores ($p < .005$), and the latter two did not differ. As predicted, the sample of children with alcohol-related effects scored lower on the measures of planning than on measures of other cognitive processes. Effect of medication (Ritalin) revealed no differences between the children who were medicated and the nonmedicated subgroups, and the interaction between PASS component scores and medication was not significant.

In sum, children with FAS and children with other alcohol-related effects performed equally poorly on the planning component. In contrast, both the groups performed normatively in simultaneous processing. If simultaneous processing is indeed a cognitive strength for children with alcohol-related effects, and perhaps especially so for children with FAS, efforts should be made to capitalize on this strength in teaching more difficult tasks in school and to ensure that these children have opportunities to use simultaneous processing skills to experience success in school. Appropriate remediation programs to utilize their strengths in simultaneous processing and boost their strength in planning can thus be recommended. We suggest the use of the PASS cognitive enhancement program (Das et al., 1994).

Part II: Confirmatory Factor Analyses: Lost in the Woods?

Kranzler et al. (2000) administered the CAS to 155 participants. Their article is essentially a repetition of Kranzler and Keith's (1999) study. The relatively small sample of participants came from two different states in the United States, north central Florida and New York City, New York. This might have allowed capricious factors to operate that could have spoiled the data set. Hence, the Kranzler et al. data set is weakened further as a source of evidence against the CAS standardization data set obtained from more than 2,000 participants. In spite of this, their article claims to present more trustworthy data as it is "independent" of the standardization data set. The following is a statistical comment that questions their effort.

Kranzler et al. (2000), in their analyses of the factor structure of the CAS (Naglieri & Das, 1997), presented several sets of confirmatory factor analyses (CFA) results to demonstrate the structural infidelity of the CAS. The following five prominent models were analyzed: (a) a revised PASS model in which the correlations between the error variances of the Planned Codes and Sentence Repetition tests were set free; this correlated error is intended to reflect a narrow memory component by these two tests; (b) a second-order hierarchical PASS model in which the correlations among the first-order factors of the PASS were postulated to result in part from a second-order general factor psychometric g and in part from some unique ability measured by each factor; (c) a third-order hierarchical model in which the correlation between the Planning and Attention tests resulted in part from a second-order general factor G_s and the correlation of G_s with the remaining two factors (Simultaneous and Successive) resulted in part from a third-order factor psychometric g ; (d) a three-factor (PA)SS model in which the planning and attention tasks were collapsed to make one factor known as G_s and the Simultaneous and Successive factors were unaltered; and (e) a second-order model in which there are three first-order factors, (PA)SS, and the correlations among the first-order factors of the (PA)SS were postulated to result in part from a second-order general factor psychometric g and in part from some unique ability measured by each factor.

Das and Naglieri (1994) have not supported a hierarchical arrangement of the four PASS processes. Consequently, the merit of alternative models, hierarchical or otherwise, is not consistent with the PASS theory as explained in the following. The only relevant models of Kranzler et al. (2000) to be considered here are the PASS model and the revised (PA)SS model of three factors when planning and attention are combined.

For the purpose of the present study, the estimates of the covariance structures for the PASS model and the revised PASS model were recalculated, as explained in detail in the next section's statistical note. On recalculation, which is crucial to rejecting the argument in favor of planning and attention, we found a negligible difference between the two Kranzler et al. (2000) models, PASS and (PA)SS, regarding model-data fit. Hence, we suggest that there is little reason to prefer the three-factor to the four-factor solution.

Statistical Note Regarding Use of CFA

The correlation matrix provided in Kranzler et al. (2000) was analyzed using LISREL 8, which is standalone software designed to conduct CFA and test structural equation models. The results of the CFA are as follows: The chi-square for the PASS model was statistically insignificant (chi-square = 67.79, $df = 48$, $p > .01$), suggesting that the model fit the data well. The chi-square for the revised PASS model that combined planning and attention was also statistically insignificant (chi-square = 59.34, $df = 47$, $p > .01$), suggesting a good model-data fit. Furthermore, the error variances

between two tests of the CAS, Planned Codes and Sentence Repetition, had to be set free in Kranzler et al.'s confirmatory factor analysis to obtain the three factors (Simultaneous, Successive, and Planning + Attention). Kranzler et al. took the absolute difference between the chi-square values of the two models and showed that the absolute value of the difference was statistically significant at .001 level, thereby arguing that the revised PASS model provided a better fit to the data than the four-factor PASS model. However, this does not suggest that the PASS model did not provide a good fit to the data because the chi-square value associated with the PASS model is statistically insignificant as well, thus it can also support good model-data fit.

Considering the fact that both models have good fit with the data, further evaluation of the relative effectiveness of one model over another could become unnecessary, warranting no further discussion except for the criticism on using the chi-square value as the targeted evidence. We suggest that the chi-square is not a preferred statistic in this situation because it is sensitive to conceptually unrelated technical conditions, such as sample size (Bandalos, 1993) or a violation of the multivariate normality assumption (Curran, West, & Finch, 1996; Hu, Bentler, & Kano, 1992). Therefore, three additional fit indices were used: Root Mean Square Error of Approximation (RMSEA), Non-Normed Fit Index (NNFI), and Comparative Fit Index (CFI). We adopted Hu and Bentler's (1999) criteria for assessing model fit—the criteria were a value of 0.06 or lower for RMSEA, 0.90 or greater for NNFI, and 0.95 or higher for CFI. On recalculation, we found a negligible difference between the two Kranzler et al. models regarding model-data fit. The RMSEA for both the models indicated a good fit; the CFI for the PASS model revealed a poor fit, whereas it indicated a fair fit for the revised PASS model; and the NNFI for both models indicated a good fit (see Table 1).

Based on the CFA results, we conclude that both models fit the data well. However, it is difficult to decide which model fits the data better as the fit indices for both the models are very comparable (revised PASS model fits the data slightly better than the PASS model). Also, readers of the Kranzler et al. (2000) article should be aware that it is not possible for the revised PASS model to fit more poorly than the original PASS model due to a technical reason: It has one more parameter open, in which error variance between Planned Codes and Sentence Repetition tasks is set free. This approach is contradictory to the idea of confirmatory factor analysis, which is a theory-testing model as opposed to a theory-generating method like exploratory factor analysis.

Summary

In sum, Naglieri and Das (1997) have several confirmatory studies supporting four factors, and Kranzler et al. (2000) have one with a smaller sample supporting three factors slightly more than four factors. It is also important to remember that

Table 1
Confirmatory Factor Analysis Using
Keith and Kranzler Data (N = 155 students)

Models	χ^2	df	p Value	RMSEA	CFI	NNFI
PASS model	67.79	48	.031	.0518	0.932	0.906
PASS model, revised	59.34	47	.106	.0413	0.960	0.944

Note: Criteria for interpreting goodness of fit indices: root mean square error of approximation (RMSEA) should be < 0.06, Comparative Fit Index (CFI) should be > 0.95, and Non-Normed Fit Index (NNFI) should be > 0.90. PASS = planning, attention, simultaneous, and successive.

CFA is sample specific; thus, one needs to consider the pattern of many studies. The four-factor PASS structure in CFA was confirmed on four separate age groups of the standardization sample of more than 2,000 participants, thereby contributing to convergent validity evidence for the PASS model (Naglieri & Das, 1997). In any case, results from statistical procedures such as CFA present only one form of “empirical evidence.” Other kinds of evidence have been in existence in previous publications (Das, 2002; Naglieri & Das, 1997). In addition, in the present article, the two empirical studies in the previous sections add to the evidence outside factor analysis that there are many more reasons for regarding planning and attention as distinct but interdependent processes.

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