

# INDIVIDUAL DIFFERENCES IN LEARNING PERFORMANCE AND IN SCHOOL ACHIEVEMENT: PLAUSIBLE PARALLELS AND UNEXPLAINED DISCREPANCIES

Franz E. WEINERT, Andreas HELMKE, and Wolfgang SCHNEIDER  
Max Planck Institute for Psychological Research, Munich  
Federal Republic of Germany

## INTRODUCTION

Experimental research on learning cannot be limited to predicting and explaining the outcomes of simple learning processes in highly controlled settings. How theoretical generalizations derived from such experimental analyses can be applied in practice is an integral question in all modern learning research. This is particularly the case within the field of education.

True, the relationship between experimental learning research and educational psychology has a century-long history - a continuous story of disappointed hopes. In the past, some educators argued that after many years of careful and sometimes even excellent research into the nature of learning, learning theorists were apparently the only people to have derived any practical benefit from their theories.

But is such a sceptical attitude still justified today, some twenty five years after the end of the behaviourist movement in psychology and the beginning of the so-called "cognitive revolution"? Of course even today, even in cognitive learning and memory research the calls for the ecological validity of research designs are emphatic. This is particularly true for research concerned with the development of learning and memory. The reason given for current critiques of learning and memory research is that "our present understanding of memory is limited by the restricted focus on only a very special kind of memory, that is on the deliberate memory of symbolic information over short time intervals in extremely sterile situations" (Perlmutter, 1988). Fortunately, there are currently a number of research efforts trying to overcome these restrictions and focusing on everyday memory and its functions under multiple context conditions (Weinert & Perlmutter, 1988).

Another reason why the results of cognitive learning and memory research have had limited application in education is the almost exclusive focus on a search for

universal regularities and therefore neglect of individual differences. Omitting some interesting exceptions (for a review see Ackerman, 1987), experimental research into learning still firmly follows the tradition established by Hermann Ebbinghaus (1885); little attention is given to describing and explaining individual differences in learning outcomes. Only recently has this situation begun to change (cf. Weinert et al., 1988).

The neglect of individual differences in experimental research, however, was never typical in research on learning processes and academic achievement in classroom settings. Differences in achievement gains in school are so obvious, and the needs both to explain the development of such differences and to reduce some of these differences are so pressing, that even theoretically focused research has been oriented towards individual differences (Farley & Gordon, 1981). Many models of school learning are good illustrations of this approach (Bloom, 1976; Glaser, 1980; see also Haertel et al., 1983; Fraser et al., 1987).

It may appear somewhat naive to attempt any systematic comparison of the conceptualizations of individual differences in experimental and applied learning research. Quite obviously, the current models are still too fragmentary and too divergent to allow coherent theoretical conclusions. However, in spite of this, we will venture to make a comparative analysis between individual differences in achievement outcomes observed under experimental conditions, and those that occur in the classroom. The main goal underlying this attempt is to enable experimental and applied research to complement each other.

The value of such a comparative perspective is that it makes it not only possible - but almost self-evident - that applied research can profit from experimental research and that, conversely, experimental research derives stimulating ideas from classroom studies (Cronbach, 1982). This is particularly true for attempts to explain individual differences in achievement outcomes, where parallel developments as well as interesting differences are observable in the two research traditions.

Experimental research on learning and memory development explains performance differences primarily by the following four factors: (a) Memory capacity, that is, relatively stable individual characteristics of the information processing system (e.g., short-term memory capacity); (b) Intellectual abilities, that is, general intellectual competence that plays an important role in mastering learning and memory tasks; (c) Domain-specific knowledge, that is, the quantity and quality of available knowledge that is semantically related to the content of the information to be learned and recalled; (d) Learning and memory strategies, that is,

availability and metacognitively regulated use of strategies to facilitate acquisition, storage and/or retrieval of information.

In contrast to these four aspects, two other sources - namely motivation and instruction - have traditionally played no or only a minor part as explanatory factors in experimental research on learning development. Recently, however, they have come to play a much more substantial role in explanations of individual differences in memory performance.

If we compare the aspects of individual differences that are studied in experimental research with those that are predominant in classroom studies, it can be seen that the most obvious similarities are related to the impact of intelligence and domain-specific knowledge on learning outcomes. Current reviews of relevant studies make it clear that, in addition, motivational factors and characteristics of instruction are held to be particularly important elements for the analysis of individual achievement differences in schools (cf. Fraser et al., 1987). In contrast, individual differences in capacity limits of the memory system and the effective use of learning or memory strategies are less often regarded as sources of achievement variance, except, of course, in explanations of low academic achievement levels of retarded children (Weiss et al., 1986).

To compare experimental and school-related learning research, it seems reasonable to focus on a more general theoretical level. From such a perspective we can use data sets with similar but not identical variables (see Ackerman, 1987). In the following text we present two examples to illustrate our point, using the data from two studies conducted in our institute. Although both studies are focused on describing and explaining individual differences in learning and learning outcomes, they were independently designed and conducted. One of these studies is a cross-sectional study of age differences in memory performance in childhood (Körkel, 1987; Weinert et al., 1987); the other is a two-year longitudinal study of the development of mathematics achievement in the fifth and sixth grades of elementary schools (Helmke et al., 1986; Weinert & Helmke, 1987). The design of the first study is grounded in the experimental approach to developmental psychology, while that of the second study is based on the nonexperimental classroom research tradition. In spite of these different frames of reference, the two studies yield a number of interesting comparisons, because both studies focused on two topics (among others): (a) the relationship between intelligence and prior knowledge as determinants of achievement outcomes, and (b) the role of motivational variables in explaining achievement outcomes.

## INTELLIGENCE AND PRIOR KNOWLEDGE AS COGNITIVE DETERMINANTS OF LEARNING ACHIEVEMENT

Since the beginning of systematic learning research in psychological laboratories and in the classroom, intelligence has been held to play an important - perhaps even the most important - role in explaining achievement differences. This consensus among learning theorists was expressed by Hilgard, who said that "brighter people can learn things that less bright ones cannot learn" (1956, p.486).

The results of the many empirical studies conducted to test this assumption are well known: correlations between measures of intelligence and learning achievement in cognitive tasks are consistently positive. The correlation coefficients vary between .00 and .90, and their median is about .40. Although a great number of investigators find this result to be unsatisfactory from both the theoretical and practical perspectives (cf. Woodrow, 1946), other researchers are still enthusiastic in their conviction that intelligence is the best single predictor of learning achievement.

This claim, however, only applies when the content-specific knowledge relevant for mastering a learning task is ignored. The importance of content-specific knowledge was first noted in the early sixties by Gagné (1962) and Ausubel (1963). It is truly astonishing how long it took before this obvious aspect was incorporated into theoretical discussions. Siegler and Richards made a mildly sarcastic comment about this:

"For the same reasons that the fish will be the last to discover water, developmental psychologists until recently devoted almost no attention to change in children's knowledge of specific content. Such changes are so omnipresent that they seemed uninviting targets for study" (1982, p.93).

Recently, however, this situation has decidedly changed and the role of content-specific knowledge for learning, understanding and recall has become a central issue in cognitive psychology in general, and in developmental studies in particular. The most interesting aspect for the analysis of individual differences is, of course, the relative influence of domain-specific knowledge and general intellectual abilities on learning outcomes.

First, let us consider our experimental study on memory development as an example. One of the tasks in the study consisted of learning and recalling texts about a soccer game. In addition, we measured verbal and nonverbal intelligence, declarative metamemory, and content-specific knowledge base (i.e., soccer knowledge). As Table 1 shows, the correlations between cognitive prerequisites and

two criteria of learning achievement were in line with some new theoretical expectations.

Table 1: Correlations between students' cognitive prerequisites and two performance criteria in learning and recalling a soccer text (N = 185 third, fifth and seventh graders)

Predictors	Performance Criteria	
	free recall	cued recall
<i>Prior knowledge</i>		
without controlling for intelligence	.49*	.58*
after controlling for intelligence	.48*	.58*
<i>Verbal intelligence (KFT)</i>		
without controlling for prior knowledge	.08	.18
after controlling for prior knowledge	-.07	.06
<i>Nonverbal intelligence (CFT 2)</i>		
without controlling for prior knowledge	.23	.18
after controlling for prior knowledge	.18	.13

\* = significant correlation ( $p < .05$ )

The relation between content-specific knowledge and recalling a text about soccer is substantially stronger than the relation between verbal or nonverbal intelligence and text recall. The correlation between knowledge and achievement remained high after controlling for intelligence, which was not the case for the low correlations between intelligence measures and memory performance.

This correlational pattern becomes even more clear and explicit when it is tested within a model representing structural relationships. This procedure was adopted by Körkel (1987) in his dissertation, using data from the same study collected from a subsample of 121 fifth and seventh graders. Figure 1 contains the parameter estimations for the most parsimonious LISREL model.

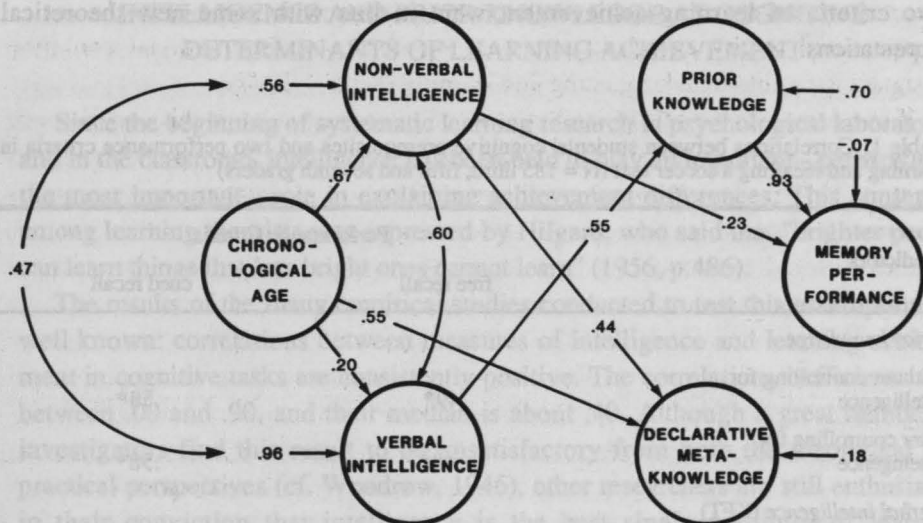


Figure 1: Resulting LISREL model representing structural relationships among chronological age, verbal and nonverbal intelligence, prior knowledge, declarative metaknowledge, and memory performance ( $N = 121$  fifth and seventh graders). (from Körkel, 1987, p. 456)

This parsimonious model is compatible with the data, as indicated by the nonsignificant Chi-square value. Chronological age, verbal and nonverbal intelligence, prior knowledge and declarative metamemory are thus shown to form an adequate basis for predicting memory performance. The most important finding concerns the superior explanatory power of content-specific knowledge over intellectual abilities. That is, content-specific knowledge is the most significant pathway in this model. It should be noted that the impact of intellectual abilities on memory performance for text can be neglected whenever content specific knowledge is very rich. In a secondary analysis of these data (Schneider et al., in press), it was shown that soccer experts significantly differing in verbal and nonverbal intelligence were absolutely comparable with regard to text recall.

In addition to this predominant pattern, several other results are also of interest. The strong impact of prior knowledge on memory performance was intensified when the learning task was made more difficult. In our study, this was done by using a text version which contained some gaps and contradictions in the information provided. Under these conditions, the differences between children with lower versus higher levels of content-specific knowledge were particularly large - apparently due to the below-average performance of the nonexperts in the difficult

text version. In such a situation, the lack of content-specific knowledge cannot be compensated for by excellent metamemory, nor by an instructional condition designed to facilitate understanding and learning (Körkel, 1987).

If one compares the role of intelligence and prior knowledge in this experimental study with the corresponding results in the study of math achievement, the results are quite similar. This is somewhat surprising because the contents of the learning material, the learning conditions, and the achievement criteria used in the two studies differed substantially. Table 2 shows the correlations between students' content-specific knowledge, intelligence, and math achievement.

Table 2: Correlations between students' cognitive prerequisites and math achievement (39 fifth grade classes)

Predictors	Achievement criteria (after 1 year)		
	total achievement score	arithmetic skills	word problems
<i>Prior knowledge (Pretest)</i>			
without controlling for intelligence	.74*	.65*	.71*
after controlling for intelligence	.66*	.58*	.59*
<i>Intelligence (KFT)</i>			
without controlling for prior knowledge	.48*	.37*	.53*
after controlling for prior knowledge	.18	.02	.32*

\* = significant correlation ( $p < .05$ )

This analysis is based on data from 631 students from 39 fifth grade classes. The correlations between prior knowledge and math achievement were consistently higher than those between intelligence and achievement. The correlations between prior knowledge and math achievement decreased nonsignificantly when intelligence was extracted. In contrast, all of the correlations between intelligence and later achievement decreased significantly when domain-specific knowledge was extracted.

Whether this correlational pattern remains invariant under differing instructional conditions is clearly a question of considerable theoretical and practical interest. On the basis of Gagné's model of learning hierarchies, one might expect that the influence of domain-specific knowledge on achievement would increase, and that the impact of general intellectual abilities would decline in the course of a well-structured and well-organized teaching-learning process.

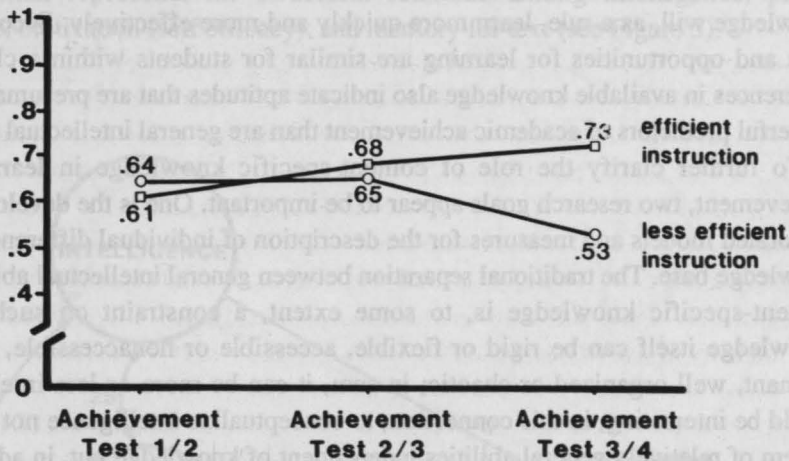
We tested this expectation in the classroom study where math achievement was assessed four times within two years. We measured prior knowledge at the beginning of the fifth grade. The subsequent three measuring points followed after about 6, 12, and 24 months. We correlated the achievement scores of the first and second, the second and third, and the third and fourth measuring points, each time extracting intelligence scores. The analyses were conducted separately for students in classes with higher and lower instructional efficiency, operationalized by low vs. high intensity of use of instructional time by the teachers (for details see Helmke et al., 1986). Figure 2 shows the results of this analysis.

Although the numerical differences between the partial correlations are moderate, the correlational pattern found in our data is characterized by an impressive consistency. This is not only the case in classrooms differing in intensity in the use of instructional time. Rather, regardless of whether one uses time on task, classroom management variables, or features of instructional quality as indicators of effective teaching: in classrooms characterized by efficient instruction, the predictive power of domain-specific prior knowledge for subsequent achievement shows an increasing trend, whereas a declining trend was found for less efficiently instructed classes. The difference is significant between Time 3 (end of 5<sup>th</sup> grade) and Time 4 (one year later).

The fact that domain-specific knowledge can explain learning achievement better than intelligence can, and that this relation is open to the influence of quality of instruction, appears to have encouraged some researchers to be very optimistic. Such optimism brings to mind the behaviourist conviction that the course of human development can largely be manipulated by external conditions. One should, however, be very cautious about such hasty conclusions. In spite of the fact that knowledge differences in many cases can be altered by effective instruction more easily than can intelligence levels, differences in knowledge have been shown to be fairly stable in school contexts. This holds true for both inter-classroom comparisons and for comparisons among students within the same classroom (Treiber & Weinert, 1985; Baumert et al., 1986; Helmke, 1988a).



Predictive power of  
prior knowledge on  
subsequent achievement  
(partial correlations)



Note: ○ Classrooms with low use of instructional time  
□ Classrooms with high use of instructional time

Figure 2: Partial correlations among the scores of four math achievement tests (after controlling for intelligence) in two different instructional settings

An additional point is that, in the majority of classrooms, achievement differences tend to increase over the course of a school year. In the math achievement study, a reduction in achievement variance was observed in only twelve out of thirty-nine classrooms, and in six of these classes, this was accompanied by above average achievement gains. However, this kind of mastery instruction was found to have a general impact that was to the disadvantage of the high achievers in math. The results of this study make it clear that instruction can reduce interindividual differences in content-specific knowledge. Yet, as pointed out in several recent state-of-the-art reviews concerning mastery learning (Arlin, 1984; Slavin, 1987), the effects to be expected under normal conditions of classroom instruction are limited.

A number of factors appear to be responsible for the stability of individual differences in domain-specific knowledge and related learning achievements. First,

there is sufficient empirical evidence to support the theoretical assumption that prior knowledge is directly relevant to learning. More specifically, prior knowledge is either a necessary or at least a facilitating factor in the acquisition of new knowledge in the same content domain. Individuals who have greater knowledge will, as a rule, learn more quickly and more effectively. Second, when time and opportunities for learning are similar for students within a classroom, differences in available knowledge also indicate aptitudes that are presumably more powerful predictors of academic achievement than are general intellectual abilities.

To further clarify the role of content-specific knowledge in learning and achievement, two research goals appear to be important. One is the development of elaborated models and measures for the description of individual differences in the knowledge base. The traditional separation between general intellectual abilities and content-specific knowledge is, to some extent, a constraint on such efforts. Knowledge itself can be rigid or flexible, accessible or nonaccessible, active or dormant, well-organized or chaotic; in sum, it can be more or less intelligent. It would be interesting, in this connection, to conceptualize intelligence not only as a system of relatively general abilities independent of knowledge but, in addition, as an attribute of content-specific knowledge.

The second task, building on the first, consists of a systematic analysis of knowledge acquisition. The processes of acquisition are probably less determined by any set of necessary and sufficient conditions than is assumed by many theories. The study of learning as a process of the acquisition of new and/or of changes in stored knowledge is in its very initial stages both in experimental research and in the classroom. This applies in particular to the description and explanation of intra- and interindividual differences, where cognitive as well as motivational factors play a role. The impact of the latter factor is the focus of the following section.

## MOTIVATIONAL FACTORS AS DETERMINANTS OF LEARNING ACHIEVEMENT

Intelligence and motivation have suffered a similar fate within learning research. It seems self-evident that both dimensions have shown a similar and lasting effect on learning processes and academic achievement. However, empirical results supporting this expectation are rare and inconsistent, especially in the case of motivation. For instance, the extremely low correlations among various indicators of achievement motivation and memory achievement found in our own study of text learning can be regarded as representative of most of the experimental learning

studies. The correlations between some self efficacy scores and recognition, free recall and cued recall performance ranged between 0 and .10. The very low effect of motivation on memory performance is particularly striking in the following model, which represents the structural relations among intelligence, prior knowledge, motivation (self efficacy), and memory for text (see Figure 3).

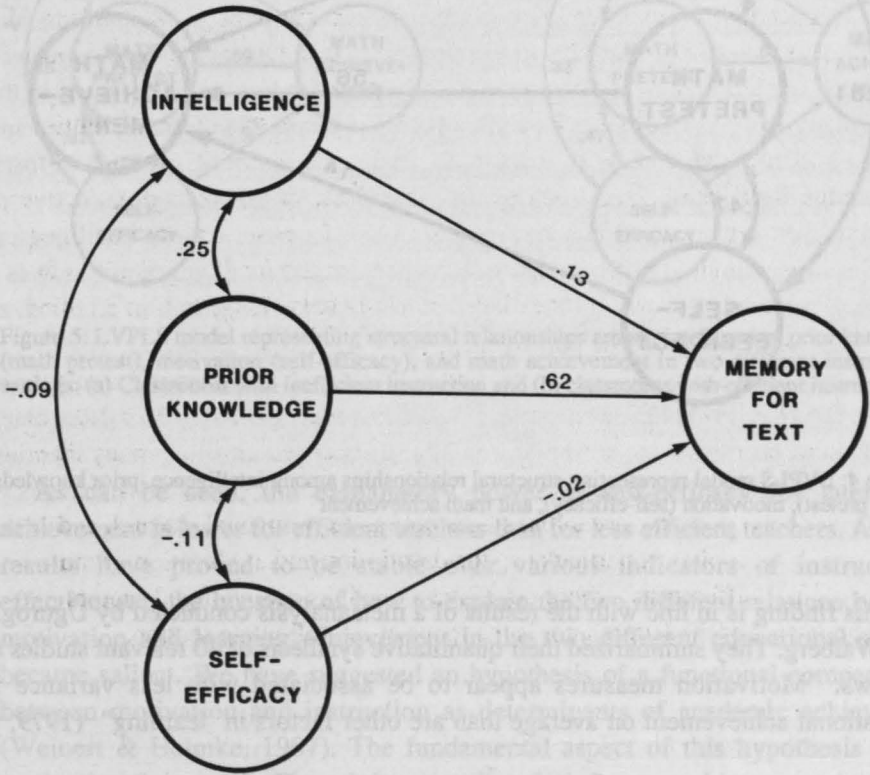


Figure 3: LVPLS model representing structural relationships among intelligence, prior knowledge, motivation (self-efficacy), and memory for text

The parallel relation between self-efficacy and achievement from our study of math learning is somewhat higher than those here, but is by no means substantial (see Figure 4).

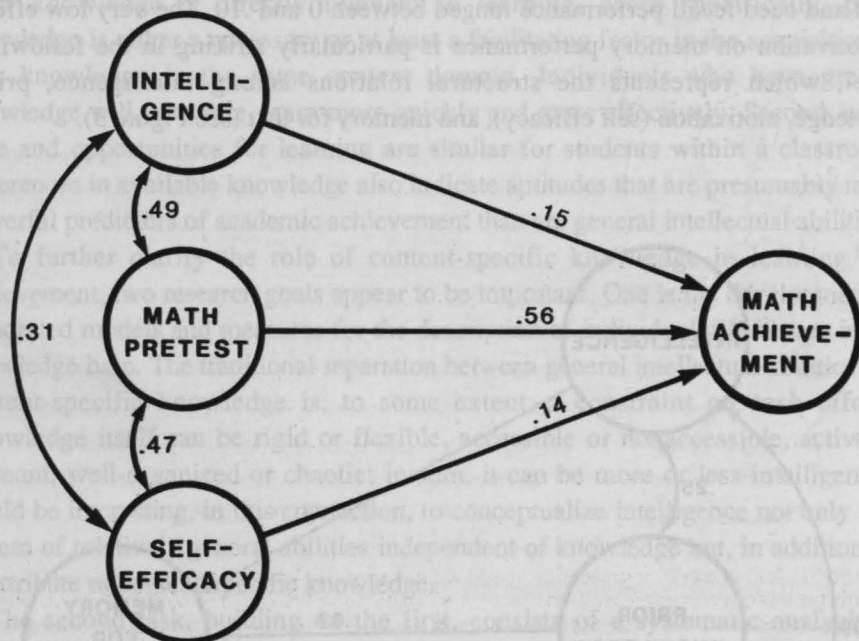


Figure 4: LVPLS model representing structural relationships among intelligence, prior knowledge (math pretest), motivation (self-efficacy), and math achievement

This finding is in line with the results of a metaanalysis conducted by Uguroglu and Walberg. They summarized their quantitative synthesis of 40 relevant studies as follows: "Motivation measures appear to be associated with less variance in educational achievement on average than are other factors in learning" (1979, p. 387).

This summary seems disappointing. A comparison between classes with efficient and nonefficient math instruction, however, produced an unexpected result that gives rise to some special analyses. Figure 5 shows the structural relationships between intelligence, prior knowledge in mathematics, self-efficacy (measured at the beginning of the 5<sup>th</sup> grade), and math achievement (measured one year later) in classes with high and low instruction efficiency (again operationalized as low vs. high use of instructional time).

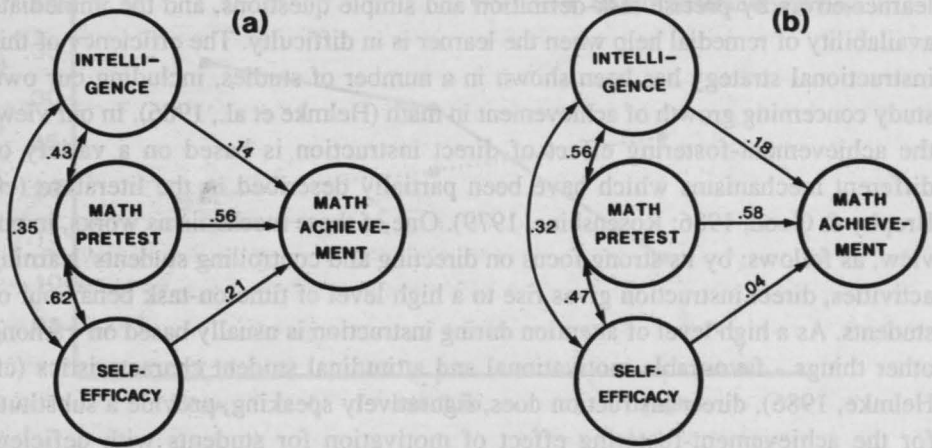


Figure 5: LVPLS model representing structural relationships among intelligence, prior knowledge (math pretest), motivation (self-efficacy), and math achievement in two different instructional settings: (a) Classrooms with inefficient instruction and (b) classrooms with efficient instruction

As can be seen, the explanatory power of self-efficacy for later math achievement is lower for efficient teachers than for less efficient teachers. As these results have proved to be stable over various indicators of instructional effectiveness, the question of how to explain the two different relations between motivation and learning achievement in the two different educational settings became salient. We have suggested an hypothesis of a functional compensation between motivation and instruction as determinants of academic achievement (Weinert & Helmke, 1987). The fundamental aspect of this hypothesis is that motivation (here, self-efficacy) does not directly influence achievement, but rather influences it indirectly via the representation of achievement goals (see Elliott & Dweck, 1988), the following learning activities, and the achievement-related behaviour. Motivated behaviour comprises a variety of facets, for example: goal-directed behaviour despite other attractive behavioural options, the selection of tasks of a specific level of difficulty, and persistence at tasks especially when problem solving is difficult or when one fails. To foster and maintain such behavioral patterns with students is, of course, the goal of many of the instructional activities of the teacher. This is exemplified by the pattern of direct instruction. This

pattern is characterized by intensive use of instructional time, concentration on learning goals, teacher-centred control of students' learning activities, continuous monitoring of the course of learning and of achievement gains, avoidance of learner-errors by precise task-definition and simple questions, and the immediate availability of remedial help when the learner is in difficulty. The efficiency of this instructional strategy has been shown in a number of studies, including our own study concerning growth of achievement in math (Helmke et al., 1986). In our view, the achievement-fostering effect of direct instruction is based on a variety of different mechanisms which have been partially described in the literature (cf. Brophy & Good, 1986; Rosenshine, 1979). One of these mechanisms works, in our view, as follows: by its strong focus on directing and controlling students' learning activities, direct instruction gives rise to a high level of time-on-task behaviour of students. As a high level of attention during instruction is usually based on - among other things - favourable motivational and attitudinal student characteristics (cf. Helmke, 1986), direct instruction does, figuratively speaking, provide a substitute for the achievement-fostering effect of motivation for students with deficient motivation.

Our hypothesis leads us to expect, then, that individual differences in self-efficacy have a comparatively strong impact on achievement when learning activities are less intensively controlled, that is, when students are given more independence and freedom in the ways they learn. Conversely, the impact of motivational differences on achievement should decrease when teachers practice the method of direct instruction. These effects are probably due less to the management component of direct instruction (that is, avoidance of classroom disturbances and the use of instructional time) than to the individual support component. That is, it is mainly the individualized behaviour-control, through direct teacher-support, which can be expected to compensate for the motivational deficits of students. To test this assumption, we first used perceived ability in math as an indicator of motivation (see Weinert & Helmke, 1987).

In order to form subgroups of classes according to the intensity of the two components of direct instruction, the 39 classes were split into terciles of low, medium and high intensity for (a) teachers' individualized supportive contact and (b) teachers' use of instructional time. Consequently, six groups resulted. The tool of multiple regression was used to estimate the amount of variance in math achievement scores explained by students' perceived ability. Figure 6 shows the results for each of the 6 groups.

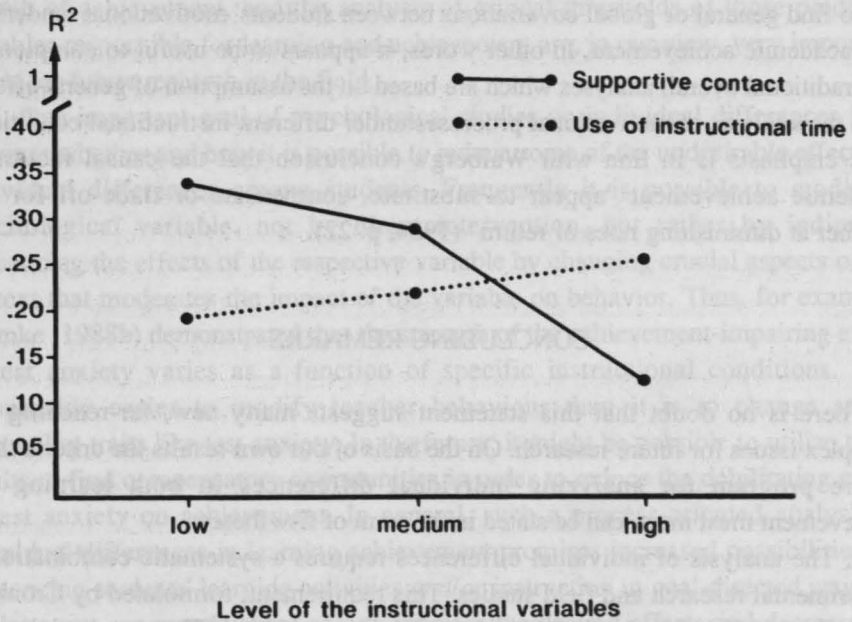


Figure 6: Determination of math achievement ( $R^2$ ) by self-concept of ability in classrooms with low, medium, or high level of two instructional variables

The pattern of results concerning the role of teachers' individualized support contact clearly backs up our hypothesis. This component of direct instruction has the effect of significantly decreasing the predictability of achievement using the students' perceived ability. The coefficients of the high support group are significantly lower than the coefficients of the medium and low support groups. Thus, in classes with intensive individualized support, perceived ability was a much less important determinant of math achievement than it was in classes where teachers gave students little individualized support. As expected, when we looked at different levels of teachers' use of instructional time, we did not find any significant trend concerning the predictive power of the students' perceived ability in math achievement.

When we take into account that intra- and interindividual differences in effort are a function of both cognitive characteristics and several motivational dimensions (Helmke, 1988b), it becomes clear that it is necessary to analyze the interplay of motivation and achievement under different conditions of instruction, rather than to

try to find general or global covariations between students' motivational tendencies and academic achievement. In other words, it appears to be useful to complement the traditional overall analyses which are based on the assumption of general effects, with the analysis of motivational processes under different instructional conditions. This emphasis is in line with Walberg's conclusion that the causal factors of academic achievement "appear to substitute, compensate or trade-off for one another at diminishing rates of return" (1984, p. 22).

### CONCLUDING REMARKS

There is no doubt that this statement suggests many new, far-reaching and complex issues for future research. On the basis of our own results the criteria that a future program for analyzing individual differences in both learning and achievement must meet, can be stated in the form of five theses:

1. The analysis of individual differences requires a systematic combination of experimental research and field studies. This requirement, formulated by Cronbach as early as 1957 in his classical Presidential Address entitled "The two disciplines of scientific psychology" - but rarely implemented in practice - is crucial, because the functioning of particular learning mechanisms can be studied only under controlled conditions. However, the variable effects of such mechanisms in the context of other factors can be uncovered and validated only on the basis of field studies.

2. The conceptualization of individual differences as stable personal traits, that determine behaviour in a consistent manner and independent of the context-characteristics of the learning task, has proved to be insufficient for explaining learning and achievement. The trait approach must be supplemented by a consideration of individual levels of acquired skills and knowledge, by process analyses of specific goals, expectancies and attributions, and last but not least, by the inclusion of aptitudes, defined as specific patterns of cognitive, emotional, and motivational learning prerequisites sensitive to specific instructional properties (Snow & Lohman, 1984).

3. In this regard special priority should be given to the description and explanation of *intraindividual* differences in learning behaviour and achievement gains at different tasks and under different instructional conditions.

4. The suggested focus on discovering mechanisms of compensation or substitution of achievement predictors requires innovative theoretical models, methods of inquiry, and statistical techniques. In particular, the identification of both necessary but not sufficient, and sufficient but not necessary conditions for



growth of achievement, and the analysis of critical thresholds of those predictor variables responsible for learning and achievement are, in our view, very important issues for future research in the field.

5. One important goal of psychological studies on individual differences is to discover whether and how it is possible to reduce some of the undesirable effects of individual differences among students. Frequently it is possible to modify a psychological variable, not by direct intervention, but rather by indirectly influencing the effects of the respective variable by changing crucial aspects of the context that moderates the impact of the variable on behavior. Thus, for example, Helmke (1988b) demonstrated that the strength of the achievement-impairing effect of test anxiety varies as a function of specific instructional conditions. It is presumably easier to modify teacher behaviour than it is to change stable personality traits like test anxiety. In the future, it might be possible to utilize these results to find compensatory opportunities in order to reduce the debilitating effect of test anxiety on achievement. In general, such a process-oriented analysis of individual differences in learning achievement promises increased possibilities for influencing students' learning activities *and/or* instruction in goal-directed ways. In the long run, we may become able to increase the desired effects and decrease the undesired effects of individual and instructional variables on learning and achievement.

## REFERENCES

- Ackerman, P.L. (1987). Individual differences in skill learning: An integration of psychometric and information processing perspectives. *Psychological Bulletin*, 102, 3-27.
- Arlin, M. (1984). Time, equality, and mastery learning. *Review of Educational Research*, 54, 65-86.
- Ausubel, D.P. (1963). *The psychology of meaningful verbal learning - An introduction to school learning*. New York, London: Grune & Stratton.
- Baumert, J., Schmitz, B., Sang, F., & Roeder, P.M. (1987). Zur Kompatibilität von Leistungsförderung und Divergenzminderung in Schulklassen mittels LISREL [On the compatibility between performance-promotion and diminishing of divergence in school-settings by means of LISREL]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 3, 249-265.
- Bloom, B.S. (1976). *Human characteristics and school learning*. New York: McGraw-Hill.
- Brophy, J.E. & Good, T.L. (1986). Teacher behavior and student achievement. In M.C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 328-375). New York: Macmillan.
- Cronbach, L.J. (1957). The two disciplines of scientific psychology. *American Psychologist*, 12, 671-684.
- Cronbach, L.J. (1982). *Designing evaluations of educational and social programs*. San Francisco: Jossey Bass.
- Ebbinghaus, H. (1885). *Über das Gedächtnis*. Leipzig: Duncker & Humblot.
- Elliott, E.S., & Dweck, C.S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54, 5-12.

- Farley, F.H. & Gordon, N.J. (1981). *Psychology and Education*. Berkeley: McCutchan Publ.
- Fraser, B.J., Walberg, H.J., Welch, W.W., & Hattie, J.A. (1987). Syntheses of educational productivity research. *International Journal of Educational Research*, 11, 145-252.
- Gagné, R.M. (1962). The acquisition of knowledge. *Psychological Review*, 69, 355-365.
- Glaser, R. (1980). General discussion: Relationships between aptitude, learning, and instruction. In R.E. Snow, P.A. Federico, & W.E. Montague (Eds.), *Aptitude, learning and instruction: Cognitive process analysis of learning and problem solving*, Vol. 2 (pp. 309-326). Hillsdale, NJ: Erlbaum.
- Haertel, G.D., Walberg, H.J., & Weinstein, T. (1983). Psychological models of educational performance: A theoretical synthesis of constructs. *Review of Educational Research*, 53, 75-91.
- Helmke, A. (1986). Student attention during instruction and achievement. In S.E. Newstead, S.H. Irvine, & P.D. Dann (Eds.), *Human Assessment: Cognition and motivation* (pp. 273-286). Dordrecht/The Netherlands: Nijhoff.
- Helmke, A. (1988a). Leistungssteigerung und Ausgleich von Leistungsunterschieden in Schulklassen: unvereinbare Ziele [Achievement growth and compensation of performance-differences within classrooms: incompatible objectives]? *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 20, 45-76.
- Helmke, A. (1988b). The role of classroom context factors for the achievement-impairing effect of test anxiety. *Anxiety Research*, 1, 37-52.
- Helmke, A., Schneider, W., & Weinert, F.E. (1986). Quality of instruction and classroom learning outcomes: The German contribution to the IEA Classroom Environment Study. *Teaching and Teacher Education*, 2, 1-31.
- Hilgard, E.R. (1956). *Theories of learning*. (2nd ed.) New York: Appleton-Century-Crofts.
- Körkel, J. (1987). *Die Entwicklung von Gedächtnis- und Metagedächtnisleistungen in Abhängigkeit von bereichsspezifischen Vorkenntnissen* [The development of memory- and metamemory-performances dependent on domain-specific prior knowledge]. Frankfurt: Peter Lang.
- Perlmutter, M. (1988). Research on memory and its development: Past, present, and future. In F.E. Weinert & M. Perlmutter (Eds.), *Memory development: Universal changes and individual differences* (pp. 353-380). Hillsdale, NJ: Erlbaum.
- Rosenshine, B.V. (1979). Content, time, and direct instruction. In P.L. Peterson, & H.J. Walberg (Eds.), *Research on teaching* (pp. 57-69). Berkeley: McCutchan.
- Schneider, W., Körkel, J., & Weinert, F.E. (in press). Domain-specific knowledge and memory performance: A comparison of high- and low-aptitude children. *Journal of Educational Psychology*.
- Siegler, R. & Richards, D.D. (1982). The development of intelligence. In R.J. Sternberg (Ed.), *Handbook of human intelligence*. Cambridge: Cambridge University Press.
- Slavin, R.E. (1987). Mastery learning reconsidered. *Review of Educational Research*, 56, 175-213.
- Snow, R., & Lohman, D.F. (1984). Toward a theory of cognitive aptitude for learning from instruction. *Journal of Educational Psychology*, 76, 347-376.
- Treiber, B., & Weinert, F.E. (1985). *Gute Schulleistungen für alle* [High scholastic achievement for all students]? Münster: Aschendorff.
- Uguroglu, M.E., & Walberg, H.J. (1979). Motivation and achievement: A quantitative synthesis. *American Educational Research Journal*, 16, 375-389.
- Walberg, H.J. (1984). Improving the productivity of America's schools. *Educational Leadership*, 41, 19-30.
- Weinert, F.E., & Helmke, A. (1987). Compensatory effects of student self-concept and instructional quality on academic achievement. In F. Halisch, & J. Kuhl (Eds.), *Motivation, intention, and volition* (pp. 233-247). Berlin: Springer.
- Weinert, F.E., & Helmke, A. (1987). Schulleistungen - Leistungen der Schule oder der Kinder [Scholastic achievement: merit of the school or of the students]? *Bild der Wissenschaft*, 24, 62-73.
- Weinert, F.E., Knopf, M., & Schneider, W. (1987). Von allgemeinen Theorien der Gedächtnisentwicklung zur Analyse spezifischer Lern- und Erinnerungsvorgänge [From general theories of memory-development to the analysis of learning- and retrieval-processes]. In M.

- Amelang (Ed.), *Bericht über den 35. Kongreß der Deutschen Gesellschaft für Psychologie in Heidelberg 1986*. Göttingen: Hogrefe, S. 447-460.
- Weinert, F.E. & Perlmutter, M. (1988). *Memory development: Universal changes and individual differences*. Hillsdale, NJ: Erlbaum.
- Weinert, F.E., Schneider, W., & Knopf, M. (1988). Individual differences in memory development across the life span. In P.B. Baltes, D.L. Featherman, & R.M. Lerner (Eds.), *Life-span development and behavior, Vol. 8* (pp. 39-85). Hillsdale, NJ: Erlbaum.
- Weiss, B., Weisz, J.R., & Bromfield, R. (1986). Performance of retarded and nonretarded persons on information processing tasks: Tests of the similar structure hypotheses. *Psychological Bulletin, 100*, 157-175.
- Woodrow, H. (1946). The ability to learn. *Psychological Review, 53*, 147-158.

MARIE DECHUYENAERE and PIET JANSSEN  
University of Leuven, Belgium

## INTRODUCTION

Much recent research on learning in higher education is focused on individual differences in academic performance of students and, more specifically, on the factors that help to predict or explain these differences. This is also the focus of our study.<sup>1</sup> In Belgium, everyone who graduates from high school can enroll at a university without an entrance examination (except for studying Civil Engineering). As a consequence, the failure rate in the first year is about 50 per cent. Our study is intended to contribute to the unravelling of this important problem. We are trying to understand the determinants of individual differences in academic achievement of freshmen. A causal model with academic performance as dependent variable is developed. In this model academic performance is influenced directly or indirectly by a combination of cognitive and motivational factors (Figure 1). The level of performance is assumed to be a function of ability and motivation. The major cognitive components are prior knowledge, procedural knowledge and learning strategies. The motivational part of the model contains achievement motivation, interest in the subject matter, self-confidence and persistence. In addition, the students' perceptions of examination requirements are also taken into account. We shall briefly outline the theoretical model, and then describe the method to test it and present the most important findings. We shall conclude with some critical remarks.