Süß, H.M., Kersting, M. & Oberauer, K. (1991). The role of intelligence and knowledge in complex problem-solving." *The German Journal of Psychology*, 16, 269-271.

tionship is intimate since intelligence tests claim to measure general problem solving abilities. Empirical studies up to now, however, have uncovered only insignificantly low to medium linear correlation coefficients. While it is argued that this is only a result of the poor reliability of problem solving measures, it might also be true that complex problems require abilities not measured by the usual intelligence tests. Processes such as the definition of goals and their elaboration, planning, organization and the coordination of activities, aimed at different aspects of the same problem, are extremely important when dealing with a complex problem, but not solving the items of an intelligence test (Dörner, 1986).

This study applied different complex problems and the Berlin Intelligence Structure Model (BIS-test, see Jäger, 1984) to determine the effects of the variation of some of these operative aspects of problems solving on the relationship to measures of intelligence. The BIS-test measures general capacity, speed, creativity, memory, and, on the content-level, verbal, numerical and imaginative abilities.

In a first study, 25 student Ss had to work with the computer simulation MORO, which consists of a net of 49 interrelated variables, simulating a small tribe of semi-nomads in the Sahel and their living conditions. Ss can ask a variety of questions and have numerous possibilities to influence the well-being of the tribe. It was their task to act as a developmental consultant for 20 years and to implement measures which improved the living conditions of the people. The quality of the Ss's effort was measured by comparing the state of some of the most important variables with the state that they would have if no measures were implemented. Under these conditions, the Pearson-correlations with the different BIS-scales varied around zero, with no coefficient being statistically significant.

In a second study, the same simulation was used. The only variation concerned the definition of goals. The 20 student Ss were given exact goal states for six variables, which, after reaching their goal-state, should be kept constant. This variation in fact prompted new outcome measures. Success was defined as the deviation between the end state and the goal state, and then a measure for the stability of the system was developed. Under these conditions, the rank-correlation coefficients between "goal-deviation" and the BIS-scales became significant, reaching an r of -.76 with "general intelligence". However, the correlation between the stability of the system and intelligence were much poorer, the correlation between "general stability" and "general intelligence" being r = .27.

In a third study the artificial system VEKTOR was used which does not attempt to simulate any part of reality and its eight variables carry no semantic meaning. As in the second study, the 20 Ss were given exact goal-states for these variables, and they were expected to try again to stabilize the system according to the goals. As in the second study two aspects of problem solving success could be measured. The findings generally replicated those of the sec-

of the BIS-test, the correlation with "general intelligence" being r = .58. The stability measures again correlated with intelligence only to a lesser degree. Interestingly, neither the goal-deviation nor the stability of two variables which, over time, behaved like a pendulum, could be inferred from the test results.

In the discussion, "one-factor-explanations" of the relations between complex problem solving processes and intelligence are criticized for being unsatisfactory. It is argued that the differences in the correlations have to be attributed to the presence of exact goal states and the limitations on the use of general knowledge. More generally, it is the reduction in the number of degrees of freedom, with complex problems allowing for individual problem solving strategies to develop, that is responsible for improvement in the interrelation with conventional intelligence measures.

References

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Jäger, A.O. (1984). Intelligenzstrukturforschung: Konkurrierende Modelle: neue Entwicklungen, Perspektiven. *Psychologische Rundschau, 35*, 21-35.

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No. 97 **Süß, H.-M., Kersting, M., & Oberauer, K.** (1991). The role of intelligence and knowledge in complex problem-solving. [Intelligenz und Wissen als Prädiktoren für Leistungen bei computersimulierten komplexen Problemen.] *Diagnostica, 37*, 334-352. ‹31 Ref., 8 Tab.›

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The study of human operations on computer-simulated problems has become established perhaps because of its poignant critique concerning the validity of classical measurements of intelligence. These ability constructs, so the critique, are not able to predict performance on complex problems. With two studies we attempted to reinvestigate the intelligence problem-solving relationship while avoiding methodological and conceptual weaknesses of previous studies:

(1) Performance scores for complex system operations have to be treated as "single act criteria". Repeated measurement is therefore necessary to guarantee the psychometric quality of the criteria via aggregation. (2) The measurement of intelligence must be differentiated. Not general intelligence, but specific abilities (inductive deductive reasoning) are predictors for control performance. (3) The semantic context of the problems activates the subject's prior knowledge. Therefore not only intelligence, but also prior knowledge should be an important predictor.

Studies: Two studies were conducted on the same subjects at a one-year interval. 214 students participated in the initial study, and 137 of these took part

As a problem-solving scenario we used the "tailor-shop". This is a simulation of a "shirt-producing factory" with 24 variables, ten of which can directly be varied by the subjects. Subjects worked on the system under conditions of intransparency. They were given an explicit and precise goal. To assess abilities we used a test for the Berlin Model of Intelligence Structure ("BIS"). On the most general level of the BIS, general intelligence is conceptualized as the integral of all 7 ability components. Below that, on a second level, very general ability components have been postulated. Two facets have been distinguished: *operations* (type of cognitive processes) including the classes "speed (B)", "memory (M)", "creativity (E)", and "complex information processing (K, similar to reasoning)", and *contents* (materiel-oriented abilities) including the classes "verbal (V)", "number (N)", and "figural (F)". General prior knowledge was assessed with a standardized economics test. In order to assess problem-specific prior knowledge we developed a content-valid test for the "tailor-shop". This test assesses system knowledge and action-related knowledge.

In the initial study, subjects first participated in the intelligence and the economics tests. Afterwards they worked three times on the "tailor-shop", each time with different starting scores. Problem-specific knowledge was assessed three times: before and after the first system-control and at the very end. In the follow-up study, subjects first worked on a test for the BIS. Then they worked on the tailor-shop twice. Before and after the system-control, they answered the problem-specific knowledge test.

Some Results. (1) Intelligence and control performance: The correlations between complex problem solving and BIS-K are moderately high, but substantial: r = .42 in the initial study and r = .34 in the follow-up study. The correlation between "K" and the aggregated overall performance measure increased to r = .47. The best predictor for control performance within the "tailor-shop" was not general intelligence, but the operative ability "K" of the BIS. (2) Knowledge and problem solving: The correlations between general economical knowledge and control performance amounted to .28 in the initial and .39 in the follow-up study. The relationship between problem-specific knowledge and control-performance was stronger. The overall score was .47 in the first and .49 in the follow-up study. (3) The role of intelligence and knowledge in problem-solving: The correlation between BIS-K and prior knowledge was .42 for problem-specific knowledge and .27 for general knowledge. With this finding the question arises whether prior knowledge can contribute substantially to the prediction of control performance above and beyond the contribution of intelligence. We have tested this question with a hierarchical analysis of regression. A significant increase in the multiple correlation could be achieved by general prior knowledge as well as problem-specific subject-knowledge. The results of these analyses were sustained in a cross-validation.

News and Announcements

Meetings and Congresses

October 11–14, 1992. 3rd European ECHA Conference, in Munich, Germany. Theme: Competence and Responsibility. Contact: ECHA Conference Sekretariat, c/o Prof. Dr. Kurt Heller, Dr. Ernst Hany, Institut für Empirische Pädagogik und Pädagogische Psychologie, Universität München, Leopoldstr. 13, D-8000 München 40, Germany.

Oct. 28–Nov. 1, 1992. 14th Congress of the Office of Political Psychology in the BDP (Association of German Psychologists), in Regensburg. Topic: The Multicultural Society—Psychological Contributions towards Intercultural Understanding and Behavior. Information: Professor Alexander Thomas, Universitätsstr. 31, 8400 Regensburg, Telephone (0941)-943-3777 or -3712, telefax (0941)-943-2305.

Nov. 13–15, 1992. 6th European Workshop on Soar, in Regensburg. Topic: Cognitive Modelling: Applications of Soar in Psychology, Linguistics and Cybernetics. Information: Dr. J. Krems, University of Regensburg, Institute for Psychology, D-8400 Regensburg, Telephone 0941-991868, E-Mail: krems @vax1. rz.uniregensburg.dbp.de.

Nov. 20, 1992. Biotechnology of repair and improvement of the brain: Neurotrophic and memory enhancing factors. Symposium during the Biotec, in Düsseldorf. Information: Professor J. P. Huston, Institute for Physiological Psychology I, Heinrich-Heine-University Düsseldorf, Universitätsstr. 1, 4000 Düsseldorf.

Further Dates for 1993:

Jan. 15–16, 1993. 9th Hamburg Symposium on the Methodology of Social Psychology, in Hamburg. Topic: Social cognition and empirical ethics research. Information: Professor Erich H. Witte, Psychological Institute I, University of Hamburg, Von-Melle-Park 6, 2000 Hamburg 13, Telephone (040)-4123-2759 and -2714, telefax (040)-41235492.

March 25–27, 1993. 4th Congress of the German Society for Behavioral Medicine and Behavioral Modification (DGVM), in Bonn. Information: Professor O. Berndt Scholz, Psychological Institute of the University of Bonn, Römerstr. 164, 5300 Bonn 1, telephone 0228-550229.

March 1993. 6th European Congress on the Psychology of Work and Organization, in Spain. Contact: Sektion Arbeits-, Betriebs- und Organisationspsychologie im BDP, Camphausenallee 4, D-5300 Bonn 2, Germany.

July 4–9, 1993. IIIrd European Congress of Psychology, in Tampere, Finland. Contact: III European Congress of Psychology, P. O. Box 905, SF-00101 Helsinki, Finland.

August 22–27, 1993. 11th International Congress on Criminology, in