

A learning oriented subjective action space as an indicator of giftedness

ALBERT ZIEGLER¹ & HEIDRUN STOEGER²

Abstract

Traditionally, in giftedness research, the intelligence quotient has been presumed to be the best predictor of high achievement levels. From the perspective of the Actiotope Model of Giftedness, however, it is merely one indicator among several on the effectiveness of the academic action repertoire. In this model, learning is considered to be more important than personal traits for attaining high levels of achievement. This is confirmed with three studies conducted with pupils in grades 8 through 11. In Study 1 it was shown that high achieving pupils in the subject of mathematics can be differentiated from other pupils according to the learning orientation of their subjective action space. High achievement can be better predicted over a temporal distance of six months through the learning orientation of the subjective action space than through intelligence. This finding was replicated in Study 2 for the scholastic subject of biology. In Study 3, an investigation was undertaken to determine whether the performance enhancing effect of a learning oriented subjective action space is also beneficial in coming to terms with experiences of failure. This premise could also be confirmed.

Key words: Giftedness, Intelligence, Actiotope, Subjective Action Space, Epistemic Beliefs

¹ Prof. Dr. Albert Ziegler, Educational Psychology, Ulm University, Albert-Einstein-Allee 47, 89081 Ulm, Germany; email: albert.ziegler@uni-ulm.de

² University of Regensburg

Introduction

In the scientific identification of gifted individuals, the measurement of intelligence plays a considerably dominant role. Several gifted programs, special schools and enrichment schemes demand evidence of a specific intelligence quotient before granting admission (Phillipson & McCann, 2007). Two points are, however, still under contention.

In the first place, there does not appear to be a clear standard as to how many gifted persons exist in a society. For instance, Robinson (2005) refers to the upper 1-3 %, Brody and Stanley (2005) the upper 3 %, Freeman (2005) the upper 5-10 %, Gagne (2005) the upper 10 %, Gordon and Bridglall (2005) the upper 15 % and Renzulli (2005) the upper 1-20 %. Richard E. Mayer (2005), in his literature review, comes to the conclusion that ca. 5 % would represent a "reasonable compromise". A point worth emphasizing here is that this 5 % compromise did not result from theoretical considerations, but is apparently the mathematical mean of the other estimates. An identification of gifted persons without the benefit of clear, theoretically founded evidence on the actual number of gifted persons in a given society does not seem to make a whole lot of sense.

The second point of contention concerns those variables which should be assessed in addition to intelligence. In all conceptions of giftedness it has been conceded that excellence cannot be predicted solely on the basis of cognitive abilities (see chapters in Sternberg & Davidson, 2005). However, recommendations concerning the supplementary variables one should assess vary greatly and range from internal catalysts such as motivation and concentration, over external catalysts such as social environment, all the way to the inclusion of chance (!) (Gagne, 2004; Heller, Perleth & Lim, 2005; Sternberg, 2003). Still, this apparently amorphous mixture of variables is not all that surprising, since no given set of characteristics consisting of IQ and additional variables has been determined to be capable of predicting excellence in a specific domain with any kind of dependability (Heller & Ziegler, 2007). Several promising theoretical endeavors in this direction are making waves in their initial stages (see Heller & Perleth, in this issue).

Next to the identification of gifted individuals through intelligence, and/or intelligence in collaboration with further variables, there are presently three noteworthy alternatives. First, instead of intelligence, achievement is often gauged as an indicator of high levels of talent. This raises a series of applied as well as theoretical problems (Ericsson, Roring & Nandagopal, 2007), since giftedness represents a *potential* to extraordinary achievement (Heller, 1991). Using achievement as a measurement for potential future achievement suggests, at the very least, a circular form of reasoning. The second possible alternative provides a direct measurement of giftedness, without necessitating a detour over intelligence or other variables. This takes the form of nominations. In the identification of gifted pupils through nomination, preferentially, the opinion of the child's teacher is taken into account to assess talent levels (Ziegler & Raul, 2000). However, these assessments are highly correlated with scholastic performance and, according to general opinion, appear to be more or less the judgments of laypersons. This rather skeptical appraisal is supported by findings of a somewhat low prognostic validity for teacher nominations (Ziegler & Stoeger, 2004). The third alternative encompasses the identification of gifted individuals on the basis of a new, recently introduced conception of giftedness (Ziegler, 2005, Ziegler; Ziegler & Stoeger H., 2007). In this approach, talent is not an attribute of an individual, but rather a label for a specific group of persons. It is the result of the scientific analysis of a researcher, which

shows that a certain person in the future will be able to develop an action repertoire, which spans a set of excellent actions. To say that a person is gifted means, in this case, that in the opinion of researcher X, person Y will at some point in time attain excellence in domain Z.

The Actiotope Model of Giftedness: A brief overview

In contrast to trait-oriented conceptions of giftedness, actions comprise the focus of the Actiotope Model of Giftedness. The development of excellence is understood as a successive expansion of an individual's action repertoire. Such a process takes place, for instance, when an individual makes the effort to move from rudimentary counting skills to master basic arithmetic functions. Subsequently, the competence to execute algebraic operations is acquired. Following this, the person in question masters the operations associated with calculus. During university studies, the mathematical action repertoire is expanded and, finally, a decision is made to attain competencies in a specific area of mathematics, for which possibly only a few hundred persons may be qualified. In a subsequent occupational career, the individual may expand his mathematical action repertoire to the point where he is capable of performing mathematical operations which no other person has yet been able to achieve. At the core of the explanations of the Actiotope Model of Giftedness is, therefore, the question of how an individual can arrive at the point of being able to establish an excellent action repertoire. The answer given to this question by most giftedness researchers would be that extraordinary cognitive abilities, via internal and external catalysts (factors, variables etc.), (e.g. Gagne, 2004; Heller et al., 2005; Sternberg, 2003) induce excellence. In the Actiotope Model of Giftedness, in contrast, pursuit is made of the question of why some persons are more successful than others in expanding their action repertoires (Ziegler, 2005). This paper provides an empirically founded answer to this question. The fact is, that persons capable of excellent accomplishments, are better able to steer the expansion of their action repertoire. The explanation here postulates a so-called subjective action space.

The actiotope of an individual is a system consisting of the individual and the sector of the environment in which he actively operates. However, over the course of the development of an individual, the environment in which he acts varies systematically, so the individual is required to adapt to it. For instance, the learning environment in primary school is more complex than that encountered in pre-school, and the situation faced in secondary school is more complex than that in primary school, etc. This means a child must be able to execute more difficult and more complex actions in primary school than required in pre-school, and in secondary school, actions become even more difficult and complex. In a direct analogy to the biological concept of a biotope, which also requires adaptations, the development of the actiotope of a person can be understood as the adaptation to a progression of environments. Adaptation, therefore, implies that more and more complex actions can be executed in increasingly complex environments. Individuals, thereby, construct an increasingly more effective action repertoire. Expansions of the action repertoire can be so extreme in some domains, such as chess, music, soccer or mathematics that we speak of excellence.

An actiotope consists of four components: the action repertoire, the environment, goals, and the subjective action space. The *action repertoire* of an individual is the sum total of all the actions that a person is basically capable of executing. The *environment* for an actiotope comprises the settings in which a person executes actions. The *goals* of a person are the

attractors and repellants of their actions. These three components draw on one another in the *subjective action space*. Analogous to the problem space in the psychology of problem solving, the subjective action space is considered to be an entity in which an individual develops and executes action plans. In the subjective action space, action courses are assembled out of the individual's action repertoire, which serve to attain a specific goal in the individual's environment. These goals can, of course, be learning goals.

In order to realize an expansion of the action repertoire, four sub-processes appear to be necessary. First, the individual must be able to focus on that sector of their environment in which new actions, those not yet contained in the action repertoire, can be executed. Second, he must be capable of recognizing action alternatives in these settings which are not yet represented in the action repertoire. Third, he must hold the opinion that this expansion of the action repertoire can be successful. Fourth, the individual should have sufficient grounds to attempt this expansion of the action repertoire.

Interestingly, in our investigations on epistemic beliefs, we found four epistemic beliefs which correspond exactly with these four sub-processes (Stoeger, 2006; Ziegler, Stoeger & Mundi, 2004). In these studies, *epistemic inclination* refers to the epistemic belief that it can be worth one's while to pay particular attention to a specific sector of the environment as a potential field of action. The conviction that, in this sector of the environment, it would be possible to execute actions which are not yet represented in the action repertoire, is referred to as *epistemic accessibility*. The term *epistemic learnability* characterizes the opinion that one is indeed capable of making the resultant expansion to one's own action repertoire. In our investigations we were also able to identify an incentive to expand one's action repertoire in a specific domain. Should an individual be of the opinion that an expansion of their action repertoire in this specific domain might also be of benefit to other domains, then the likelihood that the person will learn increases. Should the perceived *domain uniqueness* be, in contrast, high, then this likelihood decreases (Ziegler et al., 2004). In the following we will be speaking of a *learning oriented subjective action space* with respect to a specific environment (setting, domain etc.), when a person

- 1 ... observes this environment,
- 2 ... recognizes possible action alternatives in the environment which are not yet available in their action repertoire,
- 3 ... has the confidence to expand their action repertoire to the point of including at least one of these action alternatives,
- 4 ... has an incentive to make this expansion to their action repertoire.

Aims of the current research

In this contribution we would like to demonstrate that the learning orientation of the subjective action space should be taken into consideration in the identification of gifted individuals. Whether learning, and therewith performance development, will occur is determined here.

For performance development, it can be of importance that specific actions already are accessible in the action repertoire. These, for example, could include necessary previous knowledge in mathematics, without which some new information will remain incomprehensible. This, however, also includes learning actions which could be utilized in the application

of learning strategies. This is where IQ comes into play. However, contrary to other approaches, the Actiotope Model of Giftedness assumes that intelligence tests measure the effectiveness of the action repertoire in the academic area (Ziegler, 2005). The model claims that the purer the measurement of the *g-factor*, the more intense the measurement of the effectiveness of the action repertoire in performing activities which are identical in all academic domains. In strong contrast to several intelligence researchers, we share the position held by Ericsson (2007), which maintains that evidence has not yet been supplied to prove that high intelligence is the prerequisite for the expansion of an action repertoire to the point of excellent achievements. However, we explicitly concede that the effectiveness of one or more actions, whose availability in the action repertoire significantly facilitates learning in a specific domain, flows into the measurement of intelligence (IQ). If one, however, would like to predict learning which is well suited for the action repertoire of an individual (and does not overburden this individual), then we expect that the degree of a learning orientation in the subjective action space provides a better predictor of performance development than IQ, as this is rather an indicator of the effectiveness of the academic action repertoire.

In our own studies we have been able to find evidence to support this line of reasoning. We developed and validated a questionnaire to assess the proposed epistemic beliefs (Stoeger, 2006; Ziegler, Stoeger & Mundi, 2004). In a variety of cross-sectional studies, we could demonstrate that epistemic beliefs are correlated with achievement and variables which are important for achievement such as motivation, control convictions and attributions. In these studies, the correlations between epistemic beliefs and the mentioned variables were even higher than those found between these variables and measurements of intelligence. In this contribution we want to further investigate the nature of these relationships.

In Study 1 we examine three hypotheses. Hypothesis 1 is based on our differential conception of IQ and the learning oriented subjective action space. Since the former measures only one aspect of the academic action repertoire, we expect to find rather weak correlations between IQ and epistemic beliefs. Hypotheses 2 and 3 refer to the relationships between IQ and scholastic performance; and epistemic beliefs and scholastic performance. In Hypothesis 2 we presume that, among the pupils exhibiting top performances in school, both pupils with high IQ as well as pupils with a high learning goal oriented subjective action space will be overrepresented. Hypothesis 3 is the longitudinal counterpart to Hypothesis 2: IQ and a learning oriented subjective action space should both predict top performances, whereby we assume that the latter is the better predictor.

Study 1 was executed in the scholastic subject of mathematics. Study 2 examined the same hypotheses and represents a replication of Study 1 in the subject of biology.

A learning oriented subjective action space should not only promote individual learning and, in effect, performance development. It should also increase the likelihood that an individual will be better equipped to come to terms with the setbacks which inevitably materialize over the course of scholastic learning. The development of excellence is a process by which the levels defining individual achievement are permanently being set higher (Ziegler, 2008). This implies that, inevitably, several failures will arise and, for this reason, this type of learning is experienced by many to be stressful and even aversive (Ericsson et al., 2007). Several works of research show, however, that the method used to come to terms with experiences of failure and the persistence in a domain are positively influenced by the pursuit of learning oriented beliefs and goals (Ziegler, Dresel & Stoeger, in press). In Study 3, an

examination is made to determine whether a learning oriented action space is beneficial for coming to terms with failure.

Study 1

Subjects

The participants in the study were 332 pupils attending Gymnasiums in the German public school system. This school form is attended by the upper 25 % of public school pupils in terms of scholastic performance. The participants were students attending grades 8 ($n = 86$), 9 ($n = 102$), 10 ($n = 76$) and 11 ($n = 68$). The proportion of boys vs. girls in the study was balanced. Since gender did not play a role in this or either of the subsequent two studies, this variable will not be addressed in the following.

Measures

Cognitive Abilities: Cognitive abilities were measured with the Kognitive Fähigkeitstest (KFT 4-12+R) [Cognitive Abilities Test for children between grades 4 and 12] developed by Heller & Perleth (2000). This test is a revised version of the Cognitive Abilities Test (CAT) by Thorndike & Hagen (1971), which was translated into German. The unabridged version of the KFT 4-12+R consists of three test sections (verbal, quantitative, nonverbal) each of which is further divided into three subtests. In the current study an abridged format was utilized, which consisted of two subtests from the quantitative section (set comparisons and numeric series). The individual items were presented in a multiple-choice format with between 2 and 5 distracters.

Epistemic beliefs: Epistemic beliefs were measured with a questionnaire consisting of 48 items, in which various dimensions of epistemic beliefs and their sub-fields (epistemic inclination [usefulness/value, interest], epistemic acquisition [discernability, availability] and attributes of knowledge [enduring and certain, knowledge domains]) were systematically applied to the four areas of a Learner Model (person, knowledge acquisition, access to talent domain and talent domain). The items reflect permutations of the various epistemic beliefs with the four areas of the Learner Model. Two items represent each possible combination (for more information refer to Stoeger, 2006). Of the total 48 items, 16 measure epistemic inclination, 12 measure epistemic accessibility, 12 measure epistemic learnability and 8 items assess domain uniqueness. (Sample items: epistemic inclination: *In math class it is made clear (for example by the teacher or in textbooks), that math is very useful*, epistemic accessibility: *In math class you learn all of the material needed to enter the field of mathematics*, epistemic learnability: *If I want to, and if I make the effort, I can understand everything in math*, domain uniqueness: *The material covered in math class is completely different from that covered in other classes*). All items were formulated for the domain of mathematics and were to be assessed along a six-point Likert scale with the poles (1) I disagree completely to (6) I agree completely. Statistical analyses of Study 1 were conducted entirely with the total score values. The Cronbach α was, with a value of .92, satisfactory.

Scholastic achievement: In order to assess scholastic achievement, the classroom teachers informed us about the grades students had obtained on class tests in the subject of mathematics. In Germany grades range from 1 to 6. The grading scale is inverted so a lower grade indicates a better performance.

Design

Intelligence and epistemic beliefs were assessed during regular classroom instruction in the subject of mathematics several months after the start of the school year. Classroom tests which had been taken approx. 1 to 4 weeks before the survey were used as first assessments of scholastic achievement. Class tests in mathematics, which were administered after a period of about six months following the assessment of intelligence and epistemic beliefs, were used as a second set of measurement for scholastic achievement.

Results

In Hypothesis 1, we assumed that the learning orientation of the subjective actions space correlates, at most, moderately with intelligence. This hypothesis could be confirmed on an α -level of 5 %. The correlation amounted to $r = .29$.

According to Hypothesis 2, high achieving pupils should demonstrate both high intelligence quotients as well as subjective action spaces which are more highly learning oriented. Among 332 pupils, 41 obtained the highest grade possible, in other words they approximate the top achieving 3 % in their cohort. To test the hypothesis, a t-test was used to determine whether these pupils can be differentiated from the others with respect to intelligence and learning orientation of their subjective action space. The hypothesis was to be confirmed on an α -level of 5 %. The Hypothesis could be confirmed for both variables. The top pupils scored an average IQ of 124.3 and, on the six-point Likert scale for learning orientation of the subjective action space they registered an $\bar{x} = 4.12$. The results for the remaining pupils in the survey for these two variables came to IQ = 114.2 and $\bar{x} = 3.64$. The differences for both IQ and learning orientation of the subjective action space were highly significant ($t(330) = 5.85, p = 0.000$) and ($t(330) = 5.90, p = 0.000$).

In accordance with Hypothesis 3, it was presumed that the learning orientation of the subjective action space as well as IQ would be able to predict future top scholastic achievements, obtained 6 months later, among the 46 high achieving pupils. For these purposes, a binary regression ($df = 1, pin = 0.05, pout = 0.10$) was calculated. Predictor variables engaged in this regression analysis were not only IQ and epistemic beliefs but also the interaction of these two terms. The dependent variable was the dichotomized scholastic grade (pupils with top grades vs. other pupils). Significant predictors turned out to be the interaction between learning orientation of the subjective action space and IQ ($\beta = 0.04, Wald = 17.3, p = 0.000$) as well as the main effect for the learning orientation of the subjective action space ($\beta = 0.02, Wald = 17.3, p = 0.000$). The amount of variance explained supplied a *Nagelkerke* $R^2 = 15.3$ and the proportion of correct classification was 74.2 %.

Discussion

The intention of Study 1 was to test three hypotheses. First, it could be shown that IQ and the learning orientation of the subjective action space are only weakly correlated with one another, which points out two separate constructs. According to the second hypothesis, pupils who obtain a top score in the subject of mathematics can be differentiated from their classmates for both of these variables. Their IQ is higher and they demonstrate a more pronounced learning orientation in their subjective action space for the subject of mathematics. Although these results are of great importance, they merely confirm that the identification of gifted individuals should be expanded to include at least one variable other than IQ, as is suggested in several other conceptions of giftedness (e.g. Gagne, 2004; Heller, Perleth & Lim, 2005; Sternberg, 2003). Significant here is the outcome we were able to obtain in the examination of Hypothesis 3.

In fact, according to our study, IQ is not the best predictor of later scholastic high achievement. The learning orientation of the subjective action space is a much better predictor of excellent scholastic performance. Since this finding is not only highly relevant for the identification of gifted individuals, but also encompasses wide reaching theoretical implications, a replication study was conducted to reconfirm these findings.

Study 2

Study 2 is a replication of Study 1, whereby the age of the participants and the measuring instruments are the same. The only distinction is the scholastic subject. Instead of mathematics, Study 2 was conducted in the domain of biology.

Subjects

A total of 226 pupils took part in Study 2. The participants were once again attending grades 8 ($n = 62$), 9 ($n = 70$), 10 ($n = 48$) and 11 ($n = 46$) of German Gymnasiums. The proportion of boys vs. girls in the study was balanced.

Measures

As in Study 1, cognitive abilities were assessed with a short form of the quantitative section of the KFT and epistemic beliefs were evaluated with the questionnaire described above. The items on the questionnaire used to measure epistemic beliefs were reformulated for the subject of biology. As in the previous study, statistical analyses calculated for Study 2 were conducted solely with total score values. The Cronbach α was .95. To evaluate scholastic performance, the biology class teachers informed us about the class test scores in biology.

Design

The design was identical to that used for Study 1, the only differences being that the survey was conducted during regular biology class instruction, and grades supplied by the teachers were for class tests in the subject of biology. The second class test was conducted, as in Study 1, at least 6 months after intelligence and epistemic beliefs had been assessed.

Results

In Hypothesis 1 the assumption was made that the learning orientation of the subjective actions space would correlate, at best, moderately with intelligence. This assumption could be confirmed once again, although the correlation coefficient calculated for IQ and epistemic beliefs was not statistically significant this time ($r = -.05, p > 0.10$).

According to Hypothesis 2, high achieving pupils should demonstrate higher intelligence quotients as well as more pronounced learning orientations with regard to their subjective action space. To put this hypothesis to the test, t-tests were used once again to compare the pupils with the highest marks on class exams ($n = 43$) with their classmates. As in Study 1, the subjective action space of the top students was decisively more learning oriented as that for the other students ($\bar{x} = 4.12, SD = .61$ vs. $\bar{x} = 3.72, SD = .61; t(224) = 3.41, p < 0.001$). Unexpectedly, the top students in the subject of biology could not be differentiated from their classmates on the basis of intelligence (IQ = 118.3 vs. IQ = 116.5; $t(224) = .95, p > 0.10$).

Hypothesis 3 infers that IQ as well as the learning orientation of the subjective action space for the subject of biology should be able to predict high scholastic achievement in six months. A binary regression equation was calculated where, once again, IQ, epistemic beliefs and the interaction term for IQ and epistemic beliefs served as predictors ($df = 1, pin = 0.05, pout = 0.10$). The dependent variable was the dichotomized academic grade (43 pupils with the highest marks vs. the remaining pupils). Significant predictors turned out to be learning orientation of the subjective action space ($\beta = 1.34, Wald = 13.35, p = 0.000$) and IQ ($\beta = 0.08, Wald = 5.60, p < 0.01$). The proportion of correct classifications was 76.1 % and the percentage of variance explained resulted in a *Nagelkerke* $R^2 = 18.6$. Here learning orientation of the subjective action space could explain 14.0 % and IQ a further 4.6 %.

Discussion of Study 2

In Study 2, Hypothesis 1 could be reconfirmed. IQ and our questionnaire on the assessment of epistemic beliefs represent two different constructs.

In an examination of Hypothesis 2, it could again be shown that pupils with top performances demonstrate more pronounced learning oriented subjective action spaces than their fellow students. Unexpectedly, the two groups of students in the subject of biology could not be differentiated in terms of intelligence. This finding is rather surprising in light of the body of literature on the topic (Heller & Perleth, 2000).

The findings of Study 1 regarding Hypothesis 3 could only be partially replicated. It could be shown again that high scholastic achievement could be predicted on the basis of the

learning orientation of the subjective action space. However, in this case, the interaction of these variables with IQ did not reach statistical significance. In Study 2 IQ was, in addition to learning orientation of the subjective action space, a significant predictor. Why is IQ a significant predictor of later scholastic achievement in the subject of biology, although its interaction with the learning orientation of the subjective action space is not? One plausible explanation here would be that achievement in the subject of mathematics is much more dependant on mathematical prior knowledge than achievement in biology is on biological prior knowledge. The topics covered in this subject might be much more heterogeneous than those addressed in mathematics. Therefore, in expanding the action repertoire, more general action competencies, such as those assessed in intelligence tests, could be of more significance. This postulation cannot, however, be resolved on the basis of our data set.

Study 3

The most significant effect of a learning oriented subjective action space is, of course, the role it plays in insuring an expansion of the action repertoire. As emphasized by Ericsson (2007), the realization of growth in one's competencies is not necessarily a joyous experience, and may even generate feelings of aversion. Performance developments are mainly facilitated by learning activities which are located at the upper limits of one's individual capabilities. This can lead to high pressure as failure is unavoidable. Focusing the subjective action space on learning can be helpful in dealing with failure more effectively. Instead of concentrating on one's own circumstances, or the consequences of failure (see Ziegler & Stoeger, 2004), a learning oriented subjective action space insures that the subjective action space will continue, with a high degree of probability, to deliberately dedicate its energies to seeking out learning actions (see also Ziegler et al., in press). In Study 3 an investigation was made to determine whether the performance enhancing effect of a learning oriented subjective action space can also be explained by being able to better coming to terms with failure.

Subjects

The participants in Study 3 were 289 pupils attending German Gymnasiums. The subjects attended grades 8 ($n = 84$), 9 ($n = 84$), 10 ($n = 90$) and 11 ($n = 31$). The proportion of boys vs. girls was balanced.

Measures

Epistemic beliefs. To assess epistemic beliefs, the questionnaire used in Study 1 was formulated for the subject of physics. In this case, however, the four subscales epistemic inclination, epistemic accessibility, epistemic learnability, and domain uniqueness were considered separately. Reliability coefficients for all four scales were satisfactory (Cronbach α : epistemic inclination: .94, epistemic accessibility: .91, epistemic learnability: .71, domain uniqueness: .78).

Cognitive abilities. To evaluate cognitive abilities, the short form of the KFT described in Study 1 was used.

Scholastic achievement. To assess scholastic performances, the teachers gave us access to class test results for the subject of physics.

Aspiration level. The aspiration level for the subject of physics was measured with the question: *With which grade on the next examination in physics would you be satisfied.*

Confidence in own abilities. Four items from a scale developed by Dweck & Henderson (1988) were translated from English to German to measure confidence in own abilities. This scale evolved within the framework of research on achievement motivation measures how secure a person is with respect to their own cognitive abilities. The endpoints of the six-point scale are marked by statements such as *I do not really have much confidence in my abilities* vs. *I have confidence in my abilities*. The reliability of this scale was satisfactory (Cronbach $\alpha = .90$).

Control convictions. In order to assess control convictions, a six item instrument developed by Ziegler, Dresel & Schober (1998) was applied. In this scale, the authors place an emphasis on that aspect of action control which corresponds to subjective suggestibility and an individual's opportunities to formulate goal oriented conditions. The homogeneity of the scale, whereby the items were to be answered along a six-point Likert scale with the poles (1) *I disagree completely* and (6) *I agree completely*, was assessed as satisfactory (Cronbach $\alpha = .81$).

Academic elective intent. The students' academic elective intent was assessed with four self-constructed items. The students were to indicate how well they could picture themselves choosing physics as a university course of study, attending a discussion and a class in physics and pursuing a career in this field. All items began with the phrase "I can picture myself..." and were to be evaluated along a six-point Likert scale with the poles (1) *I disagree completely* and (6) *I agree completely*. (Sample items: *I can picture myself majoring in a subject related to the field of physics*, *I can picture myself attending a public discussion on a topic in the field of physics*). All items loaded onto the same factor in a factor analysis. Cronbach's α was calculated to be .89.

Design

For Study 3 an investigative design with two measuring points was utilized, with one measurement being made two weeks prior to a class test in physics and another immediately following the announcement of the exam results. This design enabled the incorporation of experiences of proximal successes and failures as a moderator into the statistical analyses. An operationalization of experienced success and/or failure could be realized through differentiations in terms of aspirations („With which grade on the next examination in physics would you be satisfied?“) for the next physics class test at the first measuring point (approx. two weeks prior to a class test in physics) and the grade that was actually obtained at the second measuring point (when the test grades were made known). Differences greater than zero represent a subjective success, while differences equal to or below zero can be evaluated as subjective failures.

Results

Subjective success and failure on the class test was measured by comparing aspiration level and the grade obtained on the class test. The average grade for this test was calculated to be 2.66, while the pupils themselves indicated they would have been satisfied, on average, with a grade of at least 3.14. A total of 96 pupils were awarded grades lower than the lowest grade they would have been satisfied with.

Four separate regression analyses were calculated (stepwise, $p_{in} = 0.05$, $p_{out} = 0.10$). The dependent variables were aspiration level, confidence in one's own abilities, control beliefs and academic elective intents. The independent variables were the five interaction terms between IQ and the four epistemic beliefs with subjective failure (difference between aspiration level and real grade on the test).

The results of these regression analyses are depicted in Table 1. Intelligence did not interact significantly with failure in any of the four regressions. In contrast, three of the four epistemic beliefs formed significant interaction terms with failure. The percentages of variance explained ranged from 14.8 % for aspiration level up to 43.3 % for confidence in one's own abilities. Closer inspection of the interactions reveals that coping with failure is more

Table 1:
Results of the regression analyses from Study 3

Predictor	Standardized β	t	$p <$
Aspiration level ($R^2 = 14.8$)			
Epistemic inclination X Failure	-	-	-
Epistemic accessibility X Failure	.54	6.49	0.001
Epistemic learnability X Failure	.20	2.18	0.05
Domain uniqueness X Failure	-.19	-2.51	0.05
IQ X Failure	-	-	-
Academic elective intent ($R^2 = 30.2$)			
Epistemic inclination X Failure	.50	4.85	0.001
Epistemic accessibility X Failure	.34	3.10	0.01
Epistemic learnability X Failure	.53	6.93	0.001
Domain uniqueness X Failure	-	-	-
IQ X Failure	-	-	-
Confidence in own's own abilities ($R^2 = 43.3$)			
Epistemic inclination X Failure	-	-	-
Epistemic accessibility X Failure	.93	13.56	0.001
Epistemic learnability X Failure	.40	5.25	0.001
Domain uniqueness X Failure	-.13	-2.12	0.05
IQ X Failure	-	-	-
Control beliefs ($R^2 = 19.5$)			
Epistemic inclination X Failure	.20	2.18	0.05
Epistemic accessibility X Failure	.37	2.97	0.01
Epistemic learnability X Failure	-	-	-
Domain uniqueness X Failure	-.21	-2.74	0.01
IQ X Failure	-	-	-

successful, when epistemic inclination, epistemic accessibility, epistemic learnability are high or when domain uniqueness is assessed as being rather marginal.

Discussion

The aim of Study 3 was to test the hypothesis that a learning oriented subjective action space is also beneficial for coping with failure. The results of the regression analyses confirm this line of reasoning emphatically. Although different epistemic beliefs are able to predict aspiration level, academic elective intents, confidence in one's own abilities as well as control convictions, this does not have an effect on the confirmation of our investigative hypothesis, but rather opens up an interesting field for future research.

Conclusion

The identification of gifted persons is an important undertaking, but is often poorly accomplished (Ziegler & Raul, 2000). One reason for this is, from our perspective, a stringent orientation on intelligence quotients and a trait conception of giftedness. In recent years, almost all models of giftedness have credited a great deal of significance to learning (Gagne, 2004; Heller, Perleth & Lim, 2005; see also Sternberg & Davidson, 2005) and, in so doing, have placed the importance of traits in question. Furthermore, there is a general consensus that it is impossible to predict excellence exclusively on the basis of cognitive variables. These insights are not, however, finding their way into general application in the identification of gifted individuals (see Grassinger, 2007).

In this paper an examination was made, on the basis of the Actiotope Model of Giftedness, as to whether a *learning orientation in the subjective action space* has a positive influence on performance development. Two effects were postulated: First, it was postulated that this type of orientation is beneficial for learning, and second, that it is advantageous in better coming to terms with failure.

In Studies 1 and 2 it was clearly shown that a learning oriented subjective action is relatively better at predicting high scholastic achievement (approximately the best 5 %) than IQ. For the practice of identifying gifted individuals, this outcome provides a clear signal that, in order to provide better assessments of which individuals actually have the potential to one day attain true excellence, the learning orientation of the subjective action space must be included in the assessment procedure. Theoretically, this finding implies that for multidimensional models of giftedness, such as the DMGT by Gagne (2004), the WICS by Sternberg (2003) or the Munich xyz-Modell by Heller & Perleth (2005), an addendum must be made to the series of internal catalysts of excellence.

On the basis of the Actiotope Model of Giftedness, these results provide further incentive for a more consequent assessment of learning oriented variables in the identification of gifted individuals. The more advantageous coping with failure through a learning oriented subjective action space, confirmed in Study 3, is a further indication of the necessity for the explicit assessment of process variables. Although we found some important hints to this approach in our studies, there are some weaknesses: The questionnaire utilized here only provides insight in coping with one specific failure. However, failures vary in their intensity,

frequency and periodicity. Such oscillations are not assessed in our questionnaire. Desirable here, would therefore be an identification of talents which not only measures certain variables at one point of time but for at least a specific period of time, and concentrate primarily on learning. A compilation of useful suggestions on this point has already been published (Grassinger, 2007).

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