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RUNNING HEAD: COURSEWORK SELECTION

Coursework selection:

A frame of reference-approach using structural equation modelling

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Abstract

Background. Choice behaviour has far-reaching consequences on students' educational careers. Previous models on course selection -- like the model of achievement-related choices (Wigfield & Eccles, 2000) and self-efficacy-theory (Bandura, 1997) -- stress the importance of ability-perceptions (self-concept of ability) as a major determinant of choice.

Aim. The article suggests a model of course selection, which assumes, that comparisons within an internal frame of reference (which were proposed by Marsh, 1986, for the association between achievement and self-concepts) also can be applied on the association between self-concepts and course selection. Therefore it is hypothesised that course selection is not only positively influenced by the self-concept with respect to the corresponding subject but also negatively by the self-concept with respect to alternative subjects. Moreover it should be tested, if the effects of previous achievement on course selection are completely mediated by the self-concepts.

Sample. The assumptions were empirically tested using a sample of 296 students from secondary school classes who could specialize for example in Chemistry or Biology in the next term.

Method. Self-concepts and course selection were assessed via questionnaire. The postulated models were tested using a structural equation modelling approach for ordinal variables.

Results. The core assumption, that course selection is determined by dimensional comparisons was supported by significant negative paths from self-concepts on the selection of non-corresponding subjects. Moreover, the effects of previous achievement on selection were completely mediated by self-concepts.

Conclusion. Previous models of choice behaviour should be extended, by considering not only the selected alternatives but also the unselected ones. The finding that the influence of achievement on choice is completely mediated by self-concepts demonstrates, that subjective interpretations of previous achievement influence subsequent behaviour.

Keywords: academic-achievement -- academic-self-concept -- choice-behaviour -- dimensional-comparison

COURSEWORK SELECTION:

A FRAME OF REFERENCE-APPROACH USING STRUCTURAL EQUATION MODELLING

By choosing a subject at school, high school or university as well as by choosing a job, an individual strongly influences his or her own educational career. After choosing an activity or a subject, students normally allocate more time to this activity or to this subject. This implies first, that the student learns more about this subject and develops expertise in this field and second, that there is less time left to engage in the subjects or activities not chosen.

Wigfield and Eccles (2000) refer to this characteristic of choice as the "psychological costs of engaging in an activity". For example the decision to enrol in a computer camp limits the possibility to spend time for learning vocabulary.

Due to the fact that choice behaviour has far-reaching implications on the development of expertise and subsequent achievement, it would be desirable to learn more about the processes underlying choice behaviour. Atkinson (1957) was one of the first authors to describe that one central problem of motivational psychology is to account for an individual's selection of one path of action among possible alternatives. Expectancy-value models like Atkinson's model of risk-taking-behaviour or the model of achievement-related choices (Wigfield & Eccles, 2000) assume, that an individual's choice, persistence and subsequent achievement depends -- among other (value-related) variables -- on the expectation of success concerning a subject or activity. Individuals choose subjects or activities, for which they hold high expectations, because they anticipate positive self-evaluations as the result of working on this subject or activity (Atkinson, 1964). Wigfield and Eccles (2000) summarize, that expectations of success and ability beliefs are empirically highly related. In a factor analytic approach, Eccles and Wigfield (1995) were not able to empirically distinguish success-expectations form ability beliefs empirically: the items representing these two constructs loaded on a single factor, whereas a two-factor solution

showed a rather poor fit to the data. Therefore, the effects of expectations and ability beliefs on choice behaviour should not be different. Moreover, Meece, Eccles Parsons, Kaczala, Goff and Futterman (1982) argued, that ability perceptions (self-concepts) are sufficient to predict course selection satisfactorily. Self-concept can be defined as an individual's perception of himself or herself (Shavelson, Hubner, & Stanton, 1976). On a more specific level in the hierarchy, the term academic self-concept refers to the representation and evaluation of an individual's abilities. In educational settings, academic self-concepts have been demonstrated to be domain- or subject-specific (Marsh, 1986). Self-concepts are assumed to be important in explaining and predicting, how people act (Shavelson et al., 1976), e.g. what alternative they choose in the face of decision-making.

The second theoretical basis for the assumption, that ability perceptions determine choice behaviour is Bandura's self-efficacy theory (1997). Self efficacy is defined as the expectation to be able to execute behaviour required to master a task. Whatever other factors operate in determining choice, they are assumed to be rooted in the belief, that one has the power to produce effects by one's own actions. Self-efficacy therefore is a pivotal factor in persons' choices (e.g. educational careers, see Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). There are some differences between the self-concept and the self-efficacy construct: Self-concepts are strongly influenced by social comparison, whereas efficacy-judgements are primarily based on mastery criteria. Furthermore, much of recent research on self-concept focussed on global self-concept measures, whereas self efficacy has often been operationalized in a more content-specific way (see Bong & Clark, 1999). However, it has to be pointed out, that self-efficacy bears resemblance to self-concept, if assessed on a subject or task-specific level: Both, self-concept and self efficacy, refer to perceptions of capabilities and these perceptions are assumed to influence the individual's choices.

Several studies corroborate the assumptions derived from the above-mentioned theories, that self-concept predicts task selection. Dickhäuser and Stiensmeier-Pelster (2003),

Ethington and Wolfe (1986; see Marsh and Yeung, 1997, for additional analyses) and Marsh (1989) reported a significant effect of self-concept (ability perceptions) on course selection in path analytic approaches. For example, students were more likely to enrol in a computer-course, if they perceived their own computer-related abilities to be high (Dickhäuser & Stiensmeier-Pelster, 2003). In two other studies (Ethington, 1991, see Marsh and Yeung, 1997, for additional analyses; Meece, Wigfield, & Eccles, 1990), self-concept was positively related to intentions to take further coursework in mathematics (see also Dickhäuser & Stiensmeier-Pelster, 2002, for similar findings concerning intentions to take computers as working tools).

One of the major questions in self-concept-research is, whether self-concept contributes to the prediction of subsequent behaviour and achievement beyond what can be predicted from previous behaviour and achievement alone (see Marsh and Yeung, 1997). The model of achievement-related choices assumes, that it is not reality itself (i.e. previous achievement), which most directly influences an individual's behaviour (like course selection), but rather the cognitive interpretation of that reality (Eccles, 1983). Consistent with this assumption, Marsh and Yeung (1997) in a path analytic approach on the prediction of course enrolment found that effects of self-concept on selection of school subjects were significant, but the effects of previous achievement did not contribute consistently beyond the effects of self-concept.

If it is not previous achievement per se, but rather its interpretation by the individual (self-concept), that determines choice, two questions of research have to be asked, *first*, how individuals form their self-concept of ability from previous achievement and *second*, how ability-perceptions influence the choice of one out of several possible alternatives.

The *first* question is addressed by the *i*nternal/*e*xternal frame of reference model (I/E-model, Marsh, 1986) assuming that individuals use two different frames of reference when forming their self-concepts of ability in different subjects. Within the *external* frame of

reference students compare their own achievement in a certain subject (e.g. English) with the achievement of their classmates. Classmates are likely to be students frame of reference for social comparison (Reuman, 1989), since students have more occasions for interactions with their classmates than for example with other students of their year group or other students at school (in Germany, for example, at the early secondary level, nearly all school subjects are taught as whole class lessons). We will refer to this form of interindividual comparison as *social* comparison. Getting better grades in English than most of the classmates can lead to the inference of high English ability; therefore, we expect positive effects of achievement on respective self-concepts. Within the *internal* frame of reference, students compare their own achievement in a certain subject (e.g. English) with their own achievement in another subject (e.g. arithmetic). We will refer to this form of ipsative comparison as *dimensional* comparison (see also Möller and Köller, 2001). For example, getting better grades in English than in mathematics can lead to the inference of high English ability; therefore, one would expect a negative effect of achievement on the non-corresponding self-concepts. In its original form, the I/E-model compared achievement and self-concepts from verbal and math subjects (Marsh, 1986). An open question is, whether dimensional comparisons also apply to subjects, which are rather similar, e.g., Biology and Chemistry, which are both science subjects. Marsh, Kong and Hau (2001) suggested, that internal comparisons would be a function of all different school subjects. They reported evidence, that to some degree dimensional comparisons take place between two verbal subjects: The authors found negative effects of English (as a foreign language) achievement on Chinese (as a native language) self-concept and of Chinese achievement on English self-concept. However, in recent investigations using German (as a native language) and Englisch (as a foreign language), Streblow and Möller (2002) and Dickhäuser (2003) found no contrast effects. Therefore, it is to some degree uncertain, whether dimensional comparisons take place within one domain. In order to find

out, whether within-domain dimensional comparisons take place, the present investigation chooses subjects from one domain (Biology, Chemistry) with a high degree of familiarity.

In order to answer the *second* question, i.e. how ability-perceptions influence the selection of one out of several possible alternatives, the present study proposes a model of course selection which tries to extend the approaches above depicted by considering not only the selected alternatives but also the unselected ones. Therefore, a multiple frame of reference-approach on the analysis of course selection is proposed, which assumes that individuals use two different frames of reference (social and dimensional) both within their ability inferences and their choices. By this suggestion, the scope of the frame of reference model which was originally developed by Marsh (1986) for the explanation of specific academic self-concepts is extended.

Whereas the Marsh-model was only concerned with the prediction of self-concepts from previous achievement (the *first* question of research) it could be assumed that similar frames of references (social and dimensional comparisons) trigger the influence of self-concepts on course selection (the *second* question of research). If we apply the two frames of reference from the Marsh-model to the prediction of course selection, we would expect positive effects of social comparison: students with higher self-concepts will be more likely to select the respective subject than students with lower self-concepts. This assumption is consistent with the above-mentioned findings from previous studies (Dickhäuser & Stiensmeier-Pelster, 2003, 2002; Ethington, 1991; Ethington & Wolfe, 1986; Marsh, 1989; Marsh & Yeung, 1997; Meece, Wigfield, & Eccles, 1990). Försterling and Morgenstern (2002) recently assumed that dimensional comparisons also play a crucial role in the prediction of choice. The authors assume, that "a realistic assessment of ones attributes (i.e., abilities) will lead to an allocation of time to those tasks for which one has high ability and a reduction of time allocated to tasks for which one has low ability." (p. 577). In a similar way Bandura et al. (2001) hypothesize, that people eliminate from choosing alternatives they

believe to be beyond their capabilities, however attractive the alternatives may be. Therefore we would expect negative effects of dimensional comparison: students' with higher self-concepts in one subject will be less likely to select another subject. This extension of previous approaches on the prediction of course selection is expressed by the two bold paths in the theoretical models shown in Figure 1.

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place Figure 1 about here

Summarizing our hypothesis we expect a model with paths from achievement on corresponding self-concepts and paths from self-concepts on corresponding coursework-selection as well as with paths from achievement on non-corresponding self-concepts and paths from self-concepts on non-corresponding coursework-selection. We expect the first paths to be positive and the latter to be negative. Remember that in the present study we are dealing with two subjects from the same domain. Therefore we will pay special attention to the question, whether the paths from achievement on non-corresponding self-concepts will be negative. This model is presented in the upper panel of Figure 1 (Model A).

In order to find out, whether the effects of previous achievement on coursework-selection are completely mediated by the corresponding self-concepts (as assumed by Eccles, 1983), we also have to compute a model with direct paths from achievement on coursework-selection (this model is presented as Model B in the lower panel of Figure 1). Given the previous findings from Marsh and Yeung (1997) we would not expect strong coefficients for these direct paths.

Method

Participants and procedure of data collection

The sample consisted of 304 grade 7 students from 12 secondary school classes (49.7 percent females). The classes were recruited from two different secondary schools (German Realschule) in two different middle-sized-towns in the North-Rhine Westphalia district, Germany. The mean age of the students was 13.2 years with a standard deviation of 0.63.

Parents and students were informed about the background of the study before the study was started. Students agreed to participate and obtained parental permission.

At the end of grade 7, students at secondary schools (German Realschule) have to decide, what kind of specialization they want to pursue for grade 8. If they choose to specialize in science, they have to choose, in a next step, which science subject they select. Besides Chemistry and Biology, they can also specialize in other subjects, e.g. technical science, physics or computer science. However, even though a choice of technical science, physics or computer science is theoretically possible, including attainment data, inclusion of self-concept and choice for all subjects into one model is impossible due to sample size restrictions. Therefore, we confine our analysis to Biology and Chemistry, which are the most popular science subjects in this population. Starting with grade 8, the chosen subject has the feature of a major[1]: The number of lessons per week in this specialisation course is equivalent to major subjects. Furthermore, the grades from these courses are as important for the educational career as the grades from the major subject (e.g. students are only allowed to visit upper secondary schools, if their final grade from the specialisation course is at least “3” [satisfactory]). The time of the present investigation was at the end of term 7, shortly before the students officially had to choose the courses for grade 8.

All variables were collected by means of questionnaires, which were handed out to the students during a regular class session. The scales assessing self-concepts were adapted from the self-concept scales by Dickhäuser, Schöne, Spinath and Stiensmeier-Pelster (2002). After an instruction by an experimenter, the students completed their questionnaires.

Questionnaires

The first page of the questionnaire contained questions on demographical data. Students indicated their age, class and gender. As indexes of achievement, students were asked to report their grades in Chemistry and Biology from their last reports (which they had received about four months earlier). Grades as achievement indexes were preferred, since they

are communicated to the students more directly and therefore can be better compared by the students than scores from standardized achievement tests. The grades from the last reports were considered to be very important in shaping self-concept and choice at the time of data collection. This was because teachers at schools often reminded students or parents of these grades in preparation of the course choices. In addition, the predictive power of the grades from the last report was expected to be strong, since these grades are an evaluation of student's achievement obtained during the whole first term. In four cases, students did not report their grade in Chemistry, in three cases, the grade in Biology was missing.

There is a long debate, whether self-reported data accurately reflect student's attainment data. In an early work, Kirk and Sereda (1969) found an overall correlation of .95 between self-reported grade point average (GPA) and actual GPA in university students. In a study by Goldman, Flake and Matheson (1990) the correlation ranged from .70 to .88. However, the results on the accuracy of self-reported GPA-scores are not completely applicable to the present study, as our students did not report average grades but grades in specific subjects. The only international study (of which we are aware) comparing self-reported and actual grades found correlations ranging from .90 to .95, indicating the validity of the self-reported data (Frucot & Cook, 1994). Compared to educational systems in other countries, in the German schooling system grades in a specific subject can even have more importance than the grade point average (e.g. students are refused to change to the next class level, if the grades in major subjects are unsatisfactory despite of a high GPA). Given this high importance of individual grades, we assumed that students' self-reported grades would represent a reasonable measure of achievement.

On the following pages of the questionnaire, the self-concepts for Chemistry and Biology were assessed. To control for order-effects, different versions of the questionnaire were used with permutations of the order of the subjects.

The scales assessing self-concepts were adapted from a German self-concept scale by Dickhäuser et al. (2002). In its original form, this scale measures general academic self-concept. The retest-reliability for this scale (general academic self-concept) is $r = .67$ within an interval of six month (even though achievement-information [grades from the reports], which the students had received during this interval possibly led to changes in students' self-concepts, see Schöne, Dickhäuser, Spinath, & Stiensmeier-Pelster, 2002). The scales can be easily adapted to specific school subjects. Concerning the validity of the adaptations, we found for example positive correlations between the mathematical self-concept and mathematical grades ($r = .42$, see Schöne et al., 2002). The German adaptation of the Self Description questionnaire (Hörmann, 1985) was not adequate for the present investigation for two reasons: First, and most important, the Hörmann-scale contains items explicitly focusing on the social comparison processes (e.g. "Compared to most other individuals, my verbal abilities are quite good"). Using items like these can lead to a biased estimation of the effects of social comparisons on self-concepts. Second, the German SDQ does not contain scales measuring self-concept for Chemistry and Biology. Therefore, we had to use a modified version.

We used five items each to measure the self-concepts of the students in Chemistry and Biology without focusing on internal or external comparisons. The items were based on five-point Likert scales as indicated below. (a) "In Chemistry [Biology] I feel..." "not at all gifted" [1], "very gifted" [5] (b) "Learning new things in Chemistry [Biology]..." "is very hard for me" [1], "is very easy for me" [5] (c) "I feel..." "not at all intelligent in Chemistry [Biology]" [1], "very intelligent in Chemistry [Biology]" [5] (d) "In Chemistry [Biology] I can achieve..." "nothing at all" [1], "a lot" [5] and (e) "In Chemistry [Biology], most of the tasks..." "are very hard for me" [1], "are very easy for me" [5]. The internal consistencies for the self-concept scales were good (Cronbach's α .89 [Biology], .93 [Chemistry]).

At the very end of the questionnaire, students indicated, which subject they want to take for the next term.

Models and Statistical Procedure

In order to investigate the mechanisms underlying course selection a path analytic approach was applied. As outlined in the ~~i~~Introduction two alternative models should be tested: Model A (see Figure 1, upper panel) containing only indirect effects of achievement on course selection via self-concepts in addition to the paths representing dimensional comparisons (i.e. paths from achievement on corresponding self-concepts and paths from self-concepts on corresponding coursework-selection as well as paths from achievement on non-corresponding self-concepts and paths from self-concepts on non-corresponding coursework-selection) and Model B (see Figure 1, lower panel). The two Models A and B differ in the assumption, that Model A postulated complete mediation (as per Judd & Kenny, 1981) of the effects of achievement on course selection by self-concepts whereas Model B assumes partial mediation.

The models consisted of six observed variables each, two exogenous and four endogenous ones. The exogenous variables were achievement in Biology (AC_BIO) and achievement in Chemistry (AC_CH) and the four endogenous variables were self-concept Biology (SC_BIO), self-concept Chemistry (SC_CH), course selection Biology (CS_BIO), and course selection Chemistry (CS_CH). Given the fact that the variables measuring course selection were dichotomous and achievement and self-concepts were measured on an ordinal scale the prerequisites for conventional path analysis, e. g. multivariate normality and metric scale of measurement, were not warranted. Therefore, the use of Pearson correlations or covariance matrices and Maximum Likelihood (ML) parameter estimates was not adequate. Instead, Jöreskög's structural equation modelling (SEM) approach for ordinal variables was applied (Jöreskog, 2001) which recommends the use of polychoric correlation matrices and asymptotic covariance matrices combined with Weighted Least Squares (WLS) parameter

estimates (Muthén, 1984). As demonstrated by Reuter, Hüppe, Netter and Hennig (in press) the ordinal SEM approach could also be adapted to models with dichotomous variables by calculating tetrachoric correlations instead of polychoric correlations and by also using asymptotic covariance matrices. In order to make the categorical SEM approach applicable to the present data set the two metric variables measuring self-concepts were transformed into ordinal variables by applying an ordinary rounding procedure to the scale means. Because the present data set was now a mixture between ordinal and dichotomous variables (besides two dichotomous endogenous variables [course selection Biology and Course selection Chemistry; 1 = non-selected, 2 = selected], all other variables were measured on a 5-point scale), analyses were based on tetrachoric/polychoric correlations and asymptotic covariance matrices. Parameter estimates were calculated by the WLS method. Before the models were tested, the data were screened with respect to underlying bivariate normality, an assumption needed for the computation of polychoric correlations. All analyses were conducted by LISREL 8.51 (Jörekog & Sörbom, 2001). The polychoric/tetrachoric correlations are reported in Table 1.[2]

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place Table 1 about here

Results

The assumption of underlying bivariate normality was tested by Jöreskog's RMSEA measure of population discrepancy (2001), which is similar to Steiger's (1990) root mean error of approximation (RMSEA) fit index for structural equation models. All RMSEA values (range 0.00 – 0.06) were lower than the critical value 0.1 indicating no serious effects of non-normality.

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place Figure 2 about here

The fit-indices of Model A turned out to be good or even very good ($\chi^2 = 7.90$, df = 4, $p = 0.095$, *RMSEA* = 0.058, *CFI* = 1.00, *GFI* = 1.00, *NFI* = 1.00, *SRMR* = 0.044). Nevertheless, the hypothesis that there is a dimensional comparison with respect to the

inference of the self-concepts from achievement could not be confirmed (see Figure 2). The paths from achievement Chemistry to self-concept Biology and the path from achievement Biology to self-concept Chemistry were not significant (illustrated by dotted paths in Figure 2) and the path coefficients were nearly zero. On the other hand results indicate that dimensional comparisons between the self-concepts affect course selection. This is indicated by significant negative path coefficients for the paths from SC_CH to CS_BIO and from SC_BIO to CS_CH. Moreover, all paths from the achievement variables to the respective self-concepts and from self-concepts to the respective course selections were significant. The correlation between AC_CH and AC_BIO was much higher than the correlation between the respective self-concept variables (r = .47 vs. r = .16).

Elimination of the two non-significant paths representing the effects of dimensional comparison on the inference of self-concepts further improved the model (χ^2 = 8.00, df = 6, p = 0.238, *RMSEA* = 0.034, *CFI* = 1.00, *GFI* = 1.00, *NFI* = 1.00, *SRMR* = 0.044).

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place Figure 3 about here

Model B which included two additional paths (see Figure 3), one from AC_CH to CS_CH and another one from AC_BIO to CS_BIO yielded the following fit indices: χ^2 = 6.33, df = 2, p = 0.042, *RMSEA* = 0.086, *CFI* = 1.00, *GFI* = 1.00, *NFI* = 1.00, *SRMR* = 0.038. Not only the χ^2-fit index became significant (which implies that the model does not fit the data) but also the path coefficients of the additional paths were non-significant (t = -0.10 and t = -1.25 respectively; illustrated by the dotted paths in Figure 3). Therefore, Model B assuming direct effects of achievement variables on respective course selection variables had to be rejected.

In order to prove that different structural relations in boys and girls did not cause this result, we conducted an additional multiple group analysis for Model B. Results showed that the structural relationships were invariant across gender groups. The model fit for the unrestricted model was χ^2=6.49, df=4, p=.166, RMSEA=0.065 and for the model with paths

restricted to equality the fit was χ^2=15.23, df=14, p=.363, RMSEA=0.024. The chi-square difference test indicated no significant difference between the restricted and the unrestricted model (p($\Delta\chi^2$=.557)) i.e. the estimation of the paths separately in each group does not significantly improve the overall model fit.

Discussion

Aim of the present study was to empirically extend current theories on choice behaviour, which stress the importance of previous achievement and (even more) self-concepts for choosing one out of several competing alternatives. This was done by empirically investigating a sample of 296 students from secondary school classes, which had to choose one subject in which they want to specialize the next term.

The main idea of our approach was to examine the importance of self-concepts for choice behaviour (which is in line with the model of achievement-related choices, Wigfield & Eccles, 2000) as well as to consider previous achievement as a main antecedent for self-concepts (a topic, which suggested by the internal/external frame of reference model, Marsh, 1986).

We will first discuss our findings concerning the *first* question how individuals derive information concerning their ability from previous achievements. The findings are in accordance with the assumption of the I/E-model, that students use an external frame of reference when inferring their ability from previous achievement. This assumption is supported by the positive coefficients for the paths linking subject specific achievements to the corresponding self-concepts (β = .48 [Chemistry] and β = .57 [Biology]). A possible explanation of these effects is that students who perform worse than most of their classmates in one subject more often have to conduct social upward comparisons, which can be assumed to lead to low ability perceptions (see Collins, 1996, for a detailed discussion of the effects of social upward comparison). In the same way social downward comparisons could lead to high ability perceptions. We have to take into account that the present results are derived from a

path analytic approach. The external comparison processes have not been assessed directly. However, our results are in line with other studies (e.g. Reuman, 1989) showing that actually social comparison processes affect self-related cognitions

The assumption derived from the I/E-model, that there are negative effects from Chemistry achievement on Biology self-concept and from Biology achievement on Chemistry self-concept is not supported by the data. The corresponding paths-coefficients were nearly zero and failed to reach significance. The assumptions of the I/E-model only partially seem to reflect the relations between achievements and self-concepts within subjects from one domain. Especially, our data call into question, whether dimensional comparisons of achievements from two rather similar subjects have contrasting effects on non-corresponding self-concepts. Research on the I/E-model mostly focussed on the math-verbal contrast, but Marsh et al. (2001) suggested that internal comparisons should be a function of all different school subjects. However, the evidence on this assumption is mixed. Marsh et al. (2001) found negative effects of English (as a foreign language) achievement on Chinese (as a native language) self-concept and of Chinese achievement on English self-concept in a sample in Hong Kong. As mentioned in the Introduction, Streblow and Möller (2002) and Dickhäuser (2003) failed to find contrast effects using German (as a native language) and English (as a foreign language). Possibly, in Hong Kong, the perceived differences between Chinese and English are much greater compared to the perceived differences between German and English in German samples. The assumption, that contrast effects only appear, when subjects are perceived as very distinct, is supported by findings from Möller, Pohlmann, Streblow and Kauffmann (2002). They asked their students whether they hold specific or rather global ability beliefs. They found, that internal comparisons seem to be less important for students with less specific ability beliefs (which implies that they perceive these subjects to be rather similar).

In the present investigation, we chose two subjects from the science domain with which students are equally familiar with. Our data show, that Biology and Chemistry achievement are not likely to be contrasted when students infer their abilities for these two subjects. One possible interpretation of this finding, which is in line with the results by Möller et al. (2002) is that students apply the internal frame of reference not to all school subjects but only to those, which are perceived as rather dissimilar (Math vs. English; Chinese [as native language] vs. English [as foreign language]).

Interestingly, the correlation between the achievement in Chemistry and Biology was much higher than the correlation between the self-concepts. The moderate positive correlations between the achievement-scores from different subjects are in line with previous findings (cf. Marsh & Craven, 1997). In the past literature, the low correlation between the self-concepts -- despite moderate correlations between the achievement scores -- has been interpreted in line with the I/E-model: Given the fact that the achievements are substantially correlated, the external frame of reference should lead to a positive correlation of the two self-concepts. In contrast, the internal frame of reference should lead to a negative correlation of the two self-concepts. Thus, the assumption that both frames operate jointly can explain the low correlation between the self-concepts. However, this explanation cannot be applied to the present findings, as there are no significant negative effects of the internal frame on the self-concepts. Therefore, a moderate positive correlation instead of a null-correlation (which would be expected if equally strong positive and negative effects counterbalance each other) could be observed. To explain this finding, one has to take into account that achievement (as measured by the grades from the last reports) is not the only antecedent for self-concept formation. This can easily be seen from the fact that the disturbances of the self-concept variables are greater than 0, indicating unexplained variance. Since the last report, there could have been more recent results in these two areas (e.g. teacher's evaluation of homework assignments) that could to some degree have affected the self-concepts.[3] Furthermore, ability-

beliefs held by significant others, like teachers or parents will also affect students' self-concepts (cf. Tiedemann, 2000). These influences can be different in different subjects and therefore lower the correlation between the self-concepts.

The findings concerning the *second* question how ability-perceptions influence the selection of one course out of possible alternatives, support the assumption that both, an external and an internal frame of reference operate, when students decide, which course they are going to take. The positive paths from self-concepts on selection of the corresponding subjects are in line with previous findings as well as with the theoretical models from Bandura (1997) and Wigfield and Eccles (2000), which assume, that self-concept promotes course selection. Students with higher self-concepts in Biology and Chemistry are more likely to select Biology or Chemistry as a major for the next term than students with lower self-concepts.

Even more interestingly, we found evidence for the assumption, that dimensional comparisons of self-concepts affect course selection. In a situation, in which a student has to select one out of competing subjects, he or she is most likely to choose subject A, if he or she thinks to be competent for A (this is supported by the positive paths from self-concepts on corresponding course selection) and if he or she thinks, not to be competent for the competing alternative B. Thus, for example, if a student has a high Biology self-concept, he or she is more likely to choose this subject. The positive path linking Biology self-concept and choice of Biology supports this. However, if the student's Biology self-concept is *high* and additionally his or her Chemistry self-concept is *low*, he or she is even more likely to choose Biology (cf. Marsh & Yeung, 1997). Thus, the choice of Biology is more likely if the self-concept Biology is higher than the self-concept Chemistry. This second conclusion is supported by the paths from self-concepts on non-corresponding course selection, where the paths-coefficients were -.25 for the path from self-concept Chemistry on course selection

Biology. In analogy, the coefficient was -.27 for the path from self-concept Biology on course selection Chemistry.

The perception of one's own abilities in a contrasting way allows the individual to select the subject which best matches his/her own ability profile. This contrasting perception of one's own abilities is of high functional value, because it can lead to the above-mentioned allocation of time in those activities, for which one has (ipsatively) high abilities (Försterling & Morgenstern, 2002). In a previous study on coursework-selection, Marsh and Yeung (1997) briefly reported findings from supplemental analyses which point to the same direction. As mentioned earlier, they found that self-concepts positively affect the selection of corresponding subjects. However, when they included a measure for general self-concept in their prediction, the paths from subject-specific self-concepts on course selection remained positive, whereas negative paths from general self-concept on coursework selection could be observed. Nevertheless, this is not a straightforward test of the assumption, that internal comparisons between subject-specific self-concepts determine choice, as the authors did not include two subject-specific self-concepts into their model but one subjects-specific and one global measure. These two measures are confounded, as the global self-concept measure is likely to contain elements from subject-specific self-concepts. Given these limitations of the study by Marsh and Yeung (1997), the present investigation provides a clearer test of the assumption, that internal comparison processes affect course selection, if one considers choice behaviour concerning two alternatives as well as specific self-concepts concerning the corresponding subjects (instead of one specific and one general self-concept measure like in the Marsh & Yeung-study). Given our procedure and the corresponding findings, our investigation provides an extension of previous approaches on choice behaviour, which assumes, that dimensional comparisons of self-concepts also affect choice.

An alternative interpretation concerning the directionality of the relations could be assumed: Students may first decide, which subject they want to choose. As a result of the

selection, they may increase their self-concept in the subject chosen and decrease their self-concept in the subject not chosen. However, this interpretation is not supported by the data. Once again we calculated the fit of Model B, but we interchanged choice and self-concepts. The fit of this model was poor ($\chi^2 = 11.25$, df = 2, p = 0.004, RMSEA = 0.126).

The last interesting finding from our study concerns the effects of previous achievement on subsequent behaviour. The direct paths from achievement on course selection were not significant; therefore, the effects of achievement on coursework selection can be considered to be fully mediated by the self-concepts. This finding (which is in line with the theoretical assumptions by Eccles, 1983) has important practical implications. If it is not achievement per se but rather its cognitive interpretation (i.e. the self-concept) that affects subsequent behaviour, it would be expected that self-concept-enhancement programs (cf. Marsh & Craven, 1997) successfully affect student's behaviour by changing their self-concepts.

The present study tried to predict choice behaviour in a realistic situation of course selection. This is an approach with much more external validity than previous studies analyzing choice intentions (e.g. Ethington, 1991; Meece, Wigfield, & Eccles, 1990). However, the previous study only analysed the choice of two science subjects. Further studies are needed to find out, whether the frame of reference-approach also applies to a broader range of subjects, e.g. when individuals have to choose a job or a subject at university.

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Footnotes

[1]Major subjects are Mathematics, German, and English. The number of lessons per week in the majors (four or five lessons per week) exceeds the number of lessons of other subjects (between one and four lessons per week depending on the subject). Final grades from majors are of particular importance: E.g. a student from grade 7 is not allowed to change to grade 8, if the final grade in one of them majors is "unsatisfactory". In this case, the student has to resist in grade 7 for the next year.

[2]Our sample contains students from 12 different classes from two different schools. Even though the observed results may also be influenced by level-two effects (class effects, e.g a particular biology teacher may be more popular resulting in a greater proportion of students from his/her class choosing biology) or level three-effects (school-effects, e.g. Chemistry may more attractive at one school because of a well equipped lab) the number of observations on level two and level three does not allow hierarchical linear modelling.

[3]As outlined in the method section, we used self-reported grades to measure students' achievements. In a recent study on the accuracy of self-reported grades in German students, Möller, Streblow, Pohlmann and Köller (2003) found a correlation of r = .93 between self-reported and actual grades. Furthermore, the accuracy of recall was independent of students' self-concept indicating, that the self-reported grades were not affected differentially by self-enhancement tendencies (Shepperd, 1993). Therefore, we considered the self-reported grades not to be systematically biased as a function of students' self-concept.

Table 1

Polychoric/Tetrachoric Correlation Matrix

	CS_BIO	CS_CH	SC_BIO	SC_CH	AC_BIO	AC_CH
CS_BIO	1.00					
CS_CH	-0.87	1.00				
SC_BIO	0.36	-0.13	1.00			
SC_CH	-0.11	0.35	0.28	1.00		
AC_BIO	0.18	0.06	0.47	0.29	1.00	
AC_CH	-0.21	0.30	0.24	0.54	0.47	1.00

Note. CS_BIO: course selection Biology (1 = non-selected, 2 = selected), CS_CH: course selection Chemistry (1 = non-selected, 2 = selected), SC_BIO: self-concept Biology, SC_CH: self-concept Chemistry, AC_BIO: achievement Biology, AC_CH: achievement Chemistry.

Figure Captions

Figure 1. Theoretical Model predicting Course Selection assuming complete (Model A) or partly Mediation (Model B) of the Effects of previous Achievement on Course Selection via Self-concept. +/- indicate whether positive or negative Path Coefficients are expected. The two Paths printed in bold indicate the theoretical Extension, assuming that dimensional Comparison affect Course Selection. CS_BIO: Course Selection Biology, CS_CH: Course Selection Chemistry (1 = non-selected, 2 = selected), SC_BIO: Self-concept Biology, SC_CH: Self-concept Chemistry, AC_BIO: Achievement Biology, AC_CH: Achievement Chemistry.

Figure 2. Completely standardized Solution for Model A predicting Course Selection. Dotted Paths are not significant, all other Paths $p < .05$. CS_BIO: Course Selection Biology, CS_CH: Course Selection Chemistry (1 = non-selected, 2 = selected), SC_BIO: Self-concept Biology, SC_CH: Self-concept Chemistry, AC_BIO: Achievement Biology, AC_CH: Achievement Chemistry.

Figure 3. Completely standardized Solution for Model B predicting Course Selection. Dotted Paths are not significant, all other Paths $p < .05$. CS_BIO: Course Selection Biology, CS_CH: Course Selection Chemistry (1 = non-selected, 2 = selected), SC_BIO: Self-concept Biology, SC_CH: Self-concept Chemistry, AC_BIO: Achievement Biology, AC_CH: Achievement Chemistry.