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# Relations Among Achievement, Self-Concept, and Motivation in Mathematics and Language Arts: A Longitudinal Study

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**ABSTRACT. Relations among achievement, self-concept, and motivation in mathematics and language arts were examined in a longitudinal 2-wave, 3-variable panel study. The participants were 3 cohorts of Norwegian elementary and middle school students (*N* = 1,005). The 1st data collection took place in October and November 1996, when the students in the 3 cohorts attended 3rd, 6th, and 8th grades. The 2nd data collection took place 1 academic year later. LISREL 8 was used in the separate analyses of mathematics and language arts data; the data were analyzed for each cohort by means of 6 path analyses for latent variables. In all cohorts, the results were consistent with a skill-development model of the achievement–self-concept relation, that is, the view that achievement affects subsequent self-concept. No evidence was found that self-concept affects subsequent achievement (self-enhancement model). Moreover, in the 2 oldest cohorts, motivation was affected by previous achievement. However, there was no evidence that self-concept affects subsequent motivation or achievement. Expectations of a developmental change in the achievement–self-concept relation was not supported.**

OUR PURPOSE IN THE PRESENT STUDY was to examine with a longitudinal perspective the relations among achievement, self-concept, and motivation in mathematics and language arts among third-, sixth-, and eighth-grade Norwegian students. Moderate-to-strong relations between academic achievement and academic self-concept have been found in a large body of research (e.g., Brookover & Passalacqua, 1981; Byrne & Worth Gavin, 1996; Maruyama, Rubin, & Kingsbury, 1981; Skaalvik, 1990; Skaalvik & Rankin, 1990, 1995a, 1995b; Skaalvik, Valås, & Sletta, 1994). Those researchers have found persistent correlations of .4 to .6 between achievement and self-concept. Although the relationship between academic self-concept and achievement is well established in the research literature, there is no agreement about the causal ordering of those constructs (see Byrne, 1996; Skaalvik, 1997). Several authors have pointed out that causal predominance remains an unresolved issue (Byrne, 1996; Pottebaum, Keith, & Ehly, 1986) and that it would be difficult to prove conclusively a causal direction in the relations (Wigfield, Eccles, & Pintrich, 1996). On logical and theoretical grounds, one can argue for four possible patterns of causation: (a) Achievement affects self-concept (skill-development model), (b) self-concept affects achievement (self-enhancement model), (c) achievement and self-concept affect each other, and (d) external variables affect both achievement and self-concept (see Skaalvik & Hagtvet, 1990).

The question of causal relations has practical importance because it is widely assumed that an improvement in self-concept leads to an improvement in academic achievement (self-enhancement model). Helmke (1989) and Skaalvik and Hagtvet (1990) advocated a developmental perspective on the achievement–self-concept relation. They proposed that in the early school years, a student's academic self-concept has yet to be established. During that period, self-concept may undergo a process of shaping and reshaping dominated by the influence of academic experience. As academic self-concept becomes better established and more stable, it may increasingly affect performance expectancies, motivation, and study behavior, which in turn may affect academic achievement. Thus, once ability perceptions are more firmly established, the relation between achievement and academic self-concept likely becomes reciprocal (see also Byrne & Worth Gavin, 1996; Wigfield & Karpathian, 1991). During late adolescence, self-concept of ability may even have causal priority over academic achievement (see, e.g., Chapman & Tunmer, 1997; Marsh, 1990a).

Few researchers have examined causal relations between academic achievement and self-concept, and most have estimated correlations based on cross-sectional studies (for an overview, see Byrne, 1996; Skaalvik, 1997). Consequently, most studies are unsuited as a basis for suggesting causal interpretations. In a review of research, Byrne (1984) noted that studies of causal predominance between self-concept and academic achievement must demonstrate a statistical relation between the constructs, establish time precedence, and test causal models by means of statistical techniques such as confirmatory factor analyses. Even in longitudinal designs, however, one should be careful drawing conclusions about causality (see Bollen, 1989). Research reviews have revealed that longitudinal studies that have sought to establish causal relations have yielded mixed results (see Byrne, 1984, 1986; Marsh, 1990b; Skaalvik & Hagtvet, 1990; Valås & Søvik, 1993). Still, few studies satisfy the prerequisites provided by Byrne (1984). Marsh (1990b) found only three such studies revealing mixed results (Byrne, 1984; Marsh, 1988; Shavelson & Bolus, 1982).

Following Byrne's prerequisites, researchers have addressed methodological problems in longitudinal studies by means of more sophisticated designs. Available longitudinal studies have revealed that during the elementary school years, academic achievement predominates over academic self-concept, thus supporting a skill-development model (Byrne, 1998; Helmke & van Aken, 1995; Muijs, 1997; Skaalvik & Hagtvet, 1990, 1995). Moreover, Chapman and Tunmer (1997) conducted a longitudinal study analyzing data by means of traditional path analysis (regression analysis), providing support for the skill-development model. On the other hand, studies of high school students have indicated either a reciprocal relation between academic achievement and self-concept (Marsh & Yeung, 1997) or a predominance of self-concept over achievement (Marsh, 1990a). However, Byrne (1998) found support for the skill-development model among high school students, for both general academic and mathematics achievement and self-concept.

Those studies support the developmental perspective advocated by Helmke (1989) and Skaalvik and Hagtvet (1990). That perspective holds that the achievement–self-concept relation changes in early adolescence (i.e., at the end of elementary school and the beginning of middle school). If the relation between self-concept and achievement changes during that period, research results on samples of students in late elementary school or the beginning of middle school would be expected to be less conclusive. In accordance with that reasoning, the few available studies of early adolescent students have yielded mixed results. Byrne (1998) found inconclusive results for general academic and mathematics achievement and self-concept, whereas a self-enhancement model was supported for English achievement and self-concept. Yoon, Eccles, and Wigfield (1995) found support for a skill-development model in sixth- to seventh-grade students, whereas Skaalvik and Hagtvet (1990) found a reciprocal relation. Helmke (1989) found support for a skill-development model in the fifth grade but a reciprocal relation in the sixth grade. Those seemingly contradictory results may be explained by a developmental perspective that assumes that the self-concept–achievement relation undergoes change during the period in question.

A number of studies have shown a moderate-to-strong relation between academic achievement and motivation (e.g., Skaalvik & Rankin, 1995b; Skaalvik et al., 1994). Moreover, studies have repeatedly shown strong relations between students' academic self-concept and a variety of motivational indicators. Academic self-concept has been shown to relate systematically to teachers' ratings of level of engagement and persistence in classroom activities (Skaalvik & Rankin, 1996; Skinner, Wellborn, & Connell, 1990), students' ratings of effort (Skaalvik & Rankin, 1995b), students' help-seeking behavior (Ames, 1983), and measures of intrinsic motivation (Gottfried, 1990; Harter & Connell, 1984; Mac Iver, Stipek, & Daniels, 1991; Meece, Blumenfeld, & Hoyle, 1988; Skaalvik & Rankin, 1996). Items in the Self Description Questionnaire (Marsh, 1990c), which measures self-perceived abilities and motivational state, also are strongly correlated (Skaalvik & Rankin, 1996; Tanzer, 1996).

Some studies have indicated that the effect of academic achievement on motivation is mediated through academic self-concept (Norwich, 1987; Skaalvik & Rankin, 1995b, 1996). Mac Iver et al. (1991) found a causal relation between academic self-concept and intrinsic motivation among high school students. Both variables were measured at the beginning and at the end of the semester, and intrinsic motivation was found to change in the direction predicted by academic self-concept.

## Method

### *Participants and Procedures*

We designed the present study as a two-wave, three-variable (2W3V) panel study. Three cohorts consisting of 1,005 primary and middle school students participated in the study. Whole school classes were selected by a stratified random procedure from a large region in Norway. The students in the three cohorts attended third, sixth, and eighth grades at the time of the first data collection (Time 1), which took place in October and November 1996. The second data collection took place 1 academic year later, when the students attended fourth, seventh, and ninth grades (Time 2). The cohorts were termed cohort 3_4 ($n$ = 494), cohort 6_7 ($n$ = 285), and cohort 8_9 ($n$ = 226), respectively.

At the time of the data collection, Norwegian students began attending school during the calendar year in which they turned 7. The students in elementary school normally have the same class teacher from Grade 1 to Grade 6, and the class teacher teaches most of the school subjects. Moreover, at the time of the data collection, Norwegian students moved from elementary school to middle school when they entered Grade 7. Thus, the students in cohort 6_7 changed schools between Time 1 and Time 2. The students in cohort 8_9 had different teachers in mathematics and in language arts.

### *Instruments*

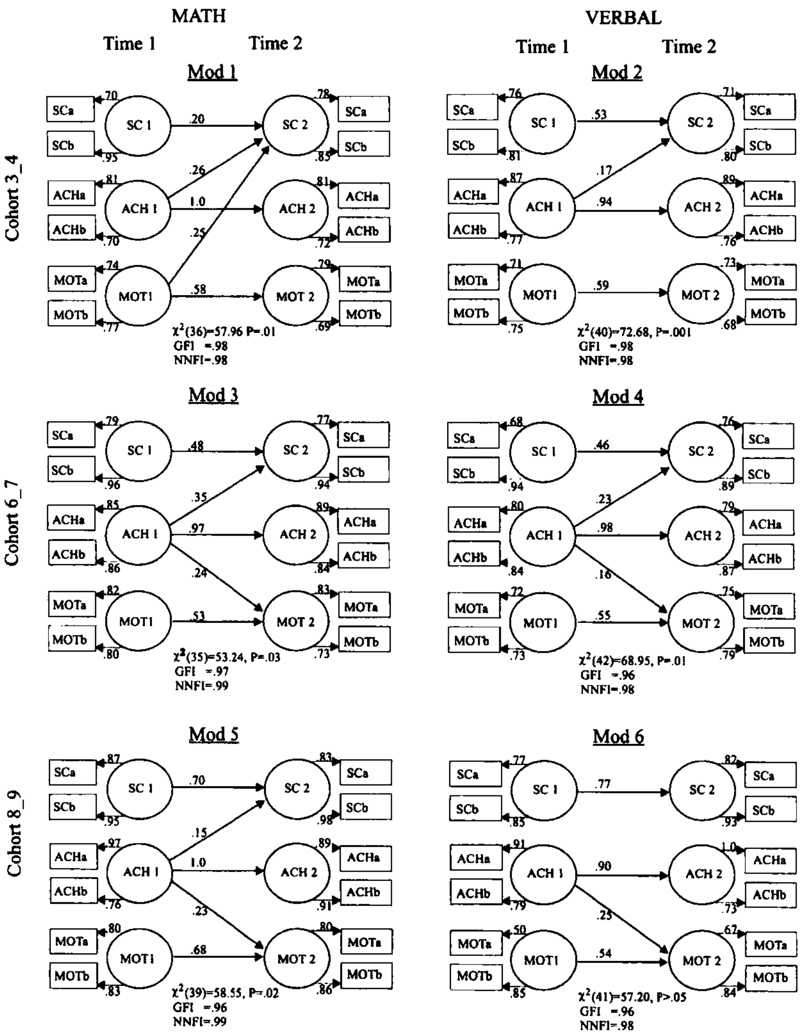
We measured mathematics and verbal achievement (MACH and VACH) with both achievement tests and teacher ratings. We created the achievement tests in collaboration with experienced teachers and designed them to cover the variety of mathematics and Norwegian problems in the curriculum in each grade. The test items ranged from very easy to very difficult. Correct answers were scored as 1, and incorrect answers were scored as 0. The teacher ratings were provided by the mathematics and Norwegian teachers on 6-point scales. The teachers were asked to rate a student's level of achievement in mathematics and in reading/writing on a scale with the following categories: (a) "The student is very weak, has problems following classroom instruction, and needs a curriculum specially adapted to his or her needs"; (b) "The student often needs individual instruction and easier or fewer tasks than his or her classmates. The student's achievements are well below average"; (c) "The student follows regular classroom instruction, but his or her achievement is slightly below average"; (d) "The student's achievements are slightly above average"; (e) "The student's achievement is well above average"; and (f) "This is a very good student. His or her achievement is far above average."

We measured mathematics and verbal motivation (MMOT and VMOT) with two motivation subscales each. We defined an Interest subscale as interest in working, or liking to work, with tasks in the respective domains in school. An Investment subscale was defined as making an effort and not giving up easily when working with mathematics and verbal tasks. For each domain, each of those constructs was measured with 5-point scales designed in the same way as the self-concept measures. Examples of items in the mathematics scales are "I like mathematics" (Interest subscale) and "I give up quickly if I get a difficult mathematics task" (Investment subscale). Response categories were *strongly agree, agree, disagree,* and *strongly disagree.*

We defined mathematics and verbal self-concept (MSC and VSC) as the general feeling of doing well or poorly in mathematics and language arts, and we measured them with 6 items from the Mathematics and Verbal subscales of the Self Description Questionnaire (Marsh, 1990c). The original scale contains 10 items measuring both the general feeling of doing well or poorly and motivational and emotional responses to mathematics. Studies of Norwegian samples have shown that those items form different factors—one Perception of Ability factor and one Motivation–Emotion factor (Skaalvik & Rankin, 1996). We therefore replaced the motivational and emotional items in the original scale (e.g., "I hate mathematics") with items measuring perceptions of doing well or poorly. Examples of mathematics items are "I always do well in mathematics," "I am hopeless in mathematics," and "I do well on tests in mathematics." Response categories were identical to the categories in the Motivation scales.

All measures displayed high reliability: The latent Achievement, Self-Concept, and Motivation factors were well defined in that all standardized factor loadings were substantial, mostly above .80 (see Figure 1 for details). The Mathematics and Verbal Self-Concept scales were each split into two subscales or indicators (Indicator 1/Indicator 2; see data analysis). We equalized the reliabilities of the Self-Concept subscales by determining the part–whole correlation for each item within a scale. We assigned items to equalize the average correlation for each subscale. At Time 1, the Mathematics Self-Concept subscales displayed Cronbach's alpha coefficients of .82/.75, .86/86, and .90/.90 in cohorts 3_4, 6_7, and 8_9, respectively. Corresponding coefficients for the verbal self-concept indicators were .76/.68, .75/.80, and .81/.86. At Time 1, the Mathematics Interest subscale (Indicator 1) displayed Cronbach's alpha coefficients of .90, .91, and .92

**FIGURE 1. Longitudinal models for achievement, self-concept, and motivation in mathematics and language arts.**




*Note.* SCa = Self-concept, Indicator a; SCb = Self-concept, Indicator b; ACHa = Achievement, test; ACHb = Achievement, teacher rating; MOTa = Investment subscale; MOTb = Interest subscale. NNFI = nonnormed fit index; GFI = goodness-of-fit index.

in cohorts 3_4, 6_7, and 8_9, respectively. Corresponding values for the Mathematics Investment subscales (Indicator 2) were .63, .76, and .86. For the Verbal Interest and Investment subscales (Indicators 1 and 2), Cronbach's alpha coefficents were .89 and .66 in cohort 3_4, .89 and .76 in cohort 6_7, and .89 and .81 in cohort 8_9.

*Data Analysis*

We analyzed the mathematics and language arts data separately for each cohort by means of path analysis for latent variables using LISREL 8. Each of the six path models specified three latent traits at each point in time: achievement, self-concept, and motivation. Each of those variables were defined by two indicators or subscales. The achievement scores and teacher ratings were used as indicators of achievement; the Interest and Investment subscales were used as indicators of motivation. Each Self-Concept scale was divided into two subscales.

We conducted the initial path analyses opening all possible paths from Time 1 to Time 2. We then eliminated cross-lagged coefficients from the model one by one if they were not statistically different from zero. Figure 1 shows the fitted models, including all stability coefficients but only significant cross-lagged coefficients. Following Marsh and Balla (1994) and Marsh, Balla, and Hau (1996), we used the Tucker–Lewis index (nonnormed fit index) to evaluate goodness of fit. We also present the chi-square statistic and goodness-of-fit indices (GFI).

## Results

Correlations among the study variables, statistical means, and standard deviations are shown in Tables 1, 2, and 3. The path models are shown in Figure 1. All models were well defined, with high correlations between the indicators and the respective variables, and with nonnormed fit indices ranging from .98 to .99.

The achievement measures for all three cohorts showed very high stability from Time 1 to Time 2 in both mathematics and language arts. The motivation measures showed moderate-to-high stability from Time 1 to Time 2 both in mathematics and in language arts in all cohorts, with stability coefficients varying between .53 and .68. There was no systematic increase in stability of motivation with increasing age. The stability of mathematics self-concept, however, increased dramatically with the age of the students. Stability was very low and nonsignificant in cohort 3_4 (.20); it increased with age (.48 and .70 for cohorts 6_7 and 8_9, respectively). The stability coefficients for language arts self-concept were significant in all cohorts. Still, it was quite moderate in the two youngest cohorts (.53 and . 46) and high (.77) in cohort 8_9. Those results support part of the developmental perspective advocated by Skaalvik and Hagtvet

**TABLE 1**
**Correlations, Means, and Standard Deviations for Cohort 3_4**

| Variable | Time | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. SCa | T1 | | .61 | .25 | .22 | .29 | .49 | .30 | .33 | .20 | .11 | .16 | .19 |
| 2. SCb | T1 | .66 | | .31 | .31 | .45 | .46 | .35 | .52 | .26 | .23 | .24 | .26 |
| 3. ACHa | T1 | .26 | .33 | | .66 | .11 | .12 | .22 | .24 | .77 | .63 | −.01 | .10 |
| 4. ACHb | T1 | .18 | .26 | .56 | | .16 | .14 | .24 | .27 | .65 | .72 | .05 | .18 |
| 5. MOTa | T1 | .45 | .53 | .15 | .19 | | .51 | .22 | .24. | .11 | .09 | .44 | .32 |
| 6. MOTb | T1 | .58 | .53 | .13 | .11 | .55 | | .18 | .28 | .10 | .10 | .33 | .47 |
| 7. SCa | T2 | .33 | .37 | .25 | .23 | .32 | .33 | | .57 | .23 | .16 | .29 | .29 |
| 8. SCb | T2 | .29 | .49 | .29 | .28 | .27 | .28 | .67 | | .28 | .24 | .35 | .33 |
| 9. ACHa | T2 | .24 | .31 | .73 | .56 | .16 | .08 | .28 | .33 | | .68 | .04 | .11 |
| 10. ACHb | T2 | .17 | .25 | .58 | .52 | .15 | .12 | .21 | .25 | .58 | | .03 | .12 |
| 11. MOTa | T2 | .16 | .31 | .09 | .13 | .41 | .36 | .45 | .48 | .10 | .12 | | .51 |
| 12. MOTb | T2 | .24 | .28 | .12 | .14 | .27 | .47 | .48 | .43 | .13 | .16 | .55 | |
| *M* Math | | 6.57 | 13.52 | 4.03 | 50.86 | 17.68 | 15.69 | 6.60 | 13.75 | 4.04 | 50.76 | 16.98 | 14.13 |
| *SD* Math | | 1.84 | 2.86 | .98 | 9.10 | 2.60 | 4.83 | 1.69 | 2.56 | .88 | 9.50 | 2.95 | 5.23 |
| *M* Verbal | | 6.61 | 13.27 | 3.84 | 50.00 | 17.05 | 14.96 | 6.77 | 13.61 | 3.79 | 50.26 | 12.28 | 13.26 |
| *SD* Verbal | | 1.76 | 2.70 | 1.03 | 9.68 | 2.81 | 5.12 | 1.53 | 2.44 | .99 | 9.32 | 3.14 | 5.00 |

*Note.* SCa = Self-concept, Indicator a; SCb = Self-concept, Indicator b; ACHa = Achievement, test; ACHb = Achievement, teacher rating; MOTa = Investment subscale; MOTb = Interest subscale; T1 = Time 1; T2 = Time 2. Verbal variables are above the diagonal, and mathematics variables are below the diagonal. If $r > .09$, then $p < .05$; if $r > .13$, then $p < .01$.

**TABLE 2**
**Correlations, Means, and Standard Deviations for Cohort 6_7**

| Variable | Time | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. SCa | T1 | | .64 | .26 | .18 | .31 | .40 | .42 | .32 | .23 | .17 | .32 | .22 |
| 2. SCb | T1 | .76 | | .42 | .36 | .46 | .42 | .36 | .52 | .33 | .38 | .37 | .28 |
| 3. ACHa | T1 | .41 | .48 | | .67 | .10 | .04 | .23 | .32 | .63 | .66 | .14 | .09 |
| 4. ACHb | T1 | .31 | .40 | .73 | | .11 | .05 | .24 | .33 | .64 | .72 | .15 | .10 |
| 5. MOTa | T1 | .57 | .63 | .26 | .18 | | .53 | .18 | .27 | .12 | .10 | .53 | .35 |
| 6. MOTb | T1 | .56 | .62 | .19 | .15 | .66 | | .17 | .24 | .06 | .05 | .33 | .49 |
| 7. SCa | T2 | .51 | .49 | .35 | .41 | .38 | .37 | | .67 | .23 | .26 | .36 | .47 |
| 8. SCb | T2 | .45 | .60 | .49 | .51 | .40 | .36 | .71 | | .35 | .34 | .52 | .52 |
| 9. ACHa | T2 | .25 | .35 | .69 | .76 | .11 | .06 | .36 | .47 | | .68 | .20 | .17 |
| 10. ACHb | T2 | .31 | .41 | .69 | .84 | .19 | .18 | .38 | .48 | .76 | | .16 | .19 |
| 11. MOTa | T2 | .30 | .40 | .23 | .30 | .51 | .40 | .56 | .68 | .22 | .27 | | .61 |
| 12. MOTb | T2 | .32 | .39 | .21 | .27 | .40 | .55 | .61 | .60 | .21 | .30 | .64 | |
| *M* Math | | 5.93 | 12.84 | 4.01 | 50.71 | 15.51 | 13.13 | 5.90 | 12.75 | 3.95 | 50.86 | 15.81 | 13.68 |
| *SD* Math | | 1.93 | 3.14 | 1.11 | 9.16 | 3.33 | 5.02 | 1.83 | 3.03 | .98 | 10.14 | 3.17 | 4.66 |
| *M* Verbal | | 6.44 | 13.29 | 3.94 | 50.52 | 15.85 | 13.06 | 6.39 | 13.10 | 3.88 | 50.79 | 15.78 | 13.54 |
| *SD* Verbal | | 1.54 | 2.51 | 1.04 | 9.42 | 2.93 | 4.40 | 1.50 | 2.56 | .94 | 9.96 | 3.22 | 4.28 |

*Note.* SCa = Self-concept, Indicator a; SCb = Self-concept, Indicator b; ACHa = Achievement, test; ACHb = Achievement, teacher rating; MOTa = Investment subscale; MOTb = Interest subscale; T1 = Time 1; T2 = Time 2. Verbal variables are above the diagonal, and mathematics variables are below the diagonal. If $r > .12$, then $p < .05$; if $r > .15$, then $p < .01$.

**TABLE 3**
**Correlations, Means, and Standard Deviations for Cohort 8_9**

| Variable | Time | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. SCa | T1 | | .64 | .34 | .32 | .27 | .48 | .52 | .54 | .33 | .29 | .16 | .37 |
| 2. SCb | T1 | .82 | | .41 | .41 | .29 | .44 | .50 | .63 | .40 | .35 | .22 | .36 |
| 3. ACHa | T1 | .42 | .55 | | .71 | .11 | .04 | .28 | .40 | .82 | .75 | .15 | .25 |
| 4. ACHb | T1 | .30 | .40 | .75 | | .08 | .04 | .29 | .40 | .71 | .79 | .10 | .27 |
| 5. MOTa | T1 | .60 | .62 | .32 | .24 | | .42 | .17 | .22 | .08 | .08 | .51 | .23 |
| 6. MOTb | T1 | .63 | .59 | .25 | .20 | .67 | | .28 | .32 | .04 | .11 | .26 | .52 |
| 7. SCa | T2 | .62 | .62 | .40 | .31 | .40 | .46 | | .76 | .29 | .29 | .42 | .58 |
| 8. SCb | T2 | .66 | .73 | .51 | .44 | .50 | .48 | .82 | | .44 | .36 | .47 | .58 |
| 9. ACHa | T2 | .39 | .52 | .87 | .74 | .30 | .27 | .42 | .53 | | .74 | .17 | .31 |
| 10. ACHb | T2 | .45 | .57 | .80 | .74 | .39 | .32 | .46 | .55 | .81 | | .12 | .26 |
| 11. MOTa | T2 | .51 | .56 | .35 | .31 | .67 | .55 | .55 | .69 | .37 | .45 | | .55 |
| 12. MOTb | T2 | .49 | .52 | .40 | .37 | .51 | .64 | .67 | .73 | .45 | .45 | .69 | |
| *M* Math | | 5.03 | 11.33 | 3.83 | 50.18 | 14.93 | 13.05 | 4.97 | 11.46 | 3.71 | 50.66 | 14.83 | 12.83 |
| *SD* Math | | 2.16 | 3.66 | 1.11 | 9.44 | 3.78 | 5.05 | 2.10 | 3.73 | 1.08 | 9.54 | 3.63 | 5.11 |
| *M* Verbal | | 6.19 | 12.39 | 3.96 | 50.82 | 15.19 | 13.17 | 6.06 | 12.62 | 3.85 | 50.78 | 14.50 | 12.87 |
| *SD* Verbal | | 1.56 | 2.86 | .98 | 9.27 | 3.20 | 4.02 | 1.70 | 2.96 | 1.01 | 9.01 | 3.50 | 4.21 |

*Note.* SCa = Self-concept, Indicator a; SCb = Self-concept, Indicator b; ACHa = Achievement, test; ACHb = Achievement, teacher rating; MOTa = Investment subscale; MOTb = Interest subscale; T1 = Time 1; T2 = Time 2. Verbal variables are above the diagonal, and mathematics variables are below the diagonal. If $r > .13$, then $p < .05$; if $r > .17$, then $p < .01$.

(1990): The results indicate that during the early school years, students' academic self-concept has yet to be established and that stability increases with age.

Five of the six models in Figure 1—both models for cohort 3_4, both models for cohort 6_7, and the mathematics model for cohort 8_9—had significant paths from achievement at Time 1 to self-concept at Time 2, whereas there were no significant paths from self-concept at Time 1 to achievement at Time 2. All four models for the two oldest cohorts also had significant paths from achievement at Time 1 to motivation at Time 2. Contrary to expectations, there were no significant paths from self-concept to motivation. In one of the mathematics models (cohort 3_4), there was a significant path from motivation at Time 1 to self-concept at Time 2. None of the models displayed any significant effect of motivation on subsequent achievement.

In the models in Figure 1, the achievement variables are defined by both test results and teacher ratings. An important question is whether that may have affected the results. Teacher ratings may be more stable than test results. We therefore conducted additional analysis defining achievement in mathematics and in language arts by either test results or teacher ratings. Those analyses revealed a somewhat higher stability of teacher ratings than of test results. However, the differences were small. Moreover, the analyses revealed no changes in the pattern of results.

## Discussion

In self-concept research, there has been an ongoing debate about causal relations between academic self-concept and academic achievement. Previous research supports a skill-development model of the relation (achievement affects self-concept) during the early elementary school years and reciprocal influence of achievement and self-concept during the high school years (see overview by Skaalvik, 1997; Skaalvik & Rankin, 1998). However, the results were less consistent for the late elementary and early middle school years. That apparent inconsistency may reflect changes in the self-perception–achievement relation that take place by the end of primary school. Helmke (1989) and Skaalvik and Hagtvet (1990) proposed a developmental model suggesting that in the early school years, the student's self-concept has yet to be established. During that period, self-concept may undergo a process of shaping and reshaping dominated by the influence of academic experience. As self-concept becomes better established and more stable, it may increasingly affect motivation and study behavior, which in turn may affect academic achievement.

Five of the six models in Figure 1 had significant paths from achievement at Time 1 to self-concept at Time 2, whereas there were no significant paths from self-concept at Time 1 to achievement at Time 2. Thus, the results of the present study are consistent with a skill-development model of the self-concept–

achievement relation in all three cohorts. Even in middle school, there was no indication of a reciprocal-effects model. Thus, even if the assumption that self-concept is more stable in the oldest cohort were supported by the data, the developmental perspective suggested by Helmke (1989) and Skaalvik and Hagtvet (1990) would not be supported. The oldest cohort in the present study attended Grade 8 at Time 1. Because Norwegian students start school during the calendar year in which they turn 7, most of the students in the oldest cohort were 15 years old at Time 1 and 16 years at Time 2. Future researchers should include a high school sample to test the developmental model at an even higher age, as the present data indicate that the change in the self-concept–academic achievement relation that is assumed in the developmental model has not yet occurred by the end of middle school.

Even though the results of the present study are consistent with a skill-development model of the self-concept–achievement relation, firm conclusions should not be drawn. The correlations between the achievement measures (stability coefficients) were very high in all models (see Figure 1). Thus, there was very little variance in achievement that was not explained by previous measures of achievement. Consequently, possible influences of self-concept and motivation on subsequent achievement may be masked. A possible solution to that problem in future studies is to allow longer time lags between the measures and to collect data at more than two points in time. Still, the high stability of the achievement measures in themselves indicate that self-concept in the present study had no strong impact on the relative achievements of the students.

In a discussion of the developmental perspective, Skaalvik (1997) assumed that as self-concept of ability becomes better established and more stable, it may increasingly affect performance through motivation and study behavior. Accordingly, we included a measure of motivation in this study. The results revealed that motivation was affected directly by achievement in the two oldest cohorts. However, we found no evidence that motivation was affected by self-concept. The path models were not designed to test if the effect of achievement on motivation was mediated through self-concept. Still, if this were the case, one would expect significant paths from self-concept at Time 1 to motivation at Time 2. Because such significant paths were not found, the results provide no indication that the effect of achievement on motivation was mediated through academic self-concept. That result also casts some doubt on the developmental model among students aged 10 to 15.

An interesting finding in this study was that mathematics motivation had a significant effect on mathematics self-concept in the youngest cohort. Because similar results were not found in language arts or in the two oldest cohorts, firm conclusions should not be drawn. However, if verified in future studies, that result may indicate a tendency among elementary school students to think that they are able to do what they are interested in. Thus, a strong interest may raise the feeling of ability, possibly through increased consciousness and reflection. Although this is mere speculation, the results point to an interesting problem for future research.

## NOTE

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