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**Title:** Adolescents' school-related self-concept mediates motor skills and psychosocial well-being

**Year:** 2014

**Version:**

**Please cite the original version:**

Viholainen, H., Aro, T., Purtsi, J., Tolvanen, A., & Cantell, M. (2014). Adolescents' school-related self-concept mediates motor skills and psychosocial well-being. *British Journal of Educational Psychology*, 84(2), 268-280.  
<https://doi.org/10.1111/bjep.12023>

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Adolescents' school-related self-concept mediates motor skills and psychosocial well-being

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### **Acknowledgement**

We thank the adolescents who participated in this study, the school principals who enabled the data collection, and B. Hands for valuable comments on the manuscript. The data collection of the study presented in this paper was supported by the Finnish Slot Machine Association (RAY).

Word count (exc. figures/tables): abstract 262 words; text body 4370 words; references 1612 words

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### Abstract

**Background:** The health benefits of exercise participation and physical activity for mental health and psychosocial well-being (PSWB) have been shown in several studies. However, one important background factor, i.e., motor skills (MS), has largely been ignored. In addition, most of the existing research focuses on poor motor skills, i.e., poor motor skills are often connected to poorer psychosocial well-being. The mechanism linking MS and PSWB is unclear. However, a preliminary suggestion has been made that self-worth or self-perceptions might mediate the association between MS and PSWB.

**Aim:** We investigated whether the self-concepts of school-related physical education (SCPE), reading (SCR) and mathematics (SCM) mediate the relationship between MS and PSWB in adolescence.

**Methods:** The study sample consisted of a second-grade female cohort (N=327), ranging in age between 12 and 16 (years) in a municipality in Central Finland. PSWB was measured by the Strengths and Difficulties Questionnaire, and the school-related SCs by the Self-Concept of Ability scale adapted for use in Finland. MS was assessed by a self-reported adolescent version of the Developmental Coordination Disorder Questionnaire. Structural mediator modeling was used to test the associations between MS and PSWB with SC as a mediator.

**Results:** First, MS was strongly associated with school-related self-concept in physical education and mathematics. However, a mediator role was observed only for SCPE, which weakly mediated peer problems. Second, MS and PSWB, especially conduct problems, showed a very strong direct association.

**Conclusions:** The study suggests that MS is connected to PSWB in adolescent girls.

Enhancement of MS could be a preventive strategy for supporting psychosocial well-being in adolescent girls.

## Adolescents' school-related self-concept mediates motor skills and psychosocial well-being

Increasing evidence has been reported on the health benefits of physical activity and exercise participation for mental health and psychosocial well-being. It has been found that those who are physically active generally have good psychosocial well-being, i.e., fewer emotional (De Moor, Beem, Stubbe, Boomsma, & De Geus, 2006) and social problems (Kirkcaldy, Shephard, & Siefen, 2002; De Moor et al., 2006). However, the relationship between motor skills and psychosocial well-being has been much less studied than the relationship between physical activity and psychosocial well-being. Moreover, most of the motor skill studies have focused on poor motor skills. These few existing studies suggest, for example, that at various ages of childhood and adolescence poor motor skills are connected to anxiety and depressive symptoms (Green, Baird, & Sugden, 2006; Piek, Bradburry, Elsey, & Tate, 2008; Pratt & Hill, 2011; Sigurdsson, van Os, & Fombonne, 2002; Skinner & Piek, 2001), which seem to multiply when accompanied by symptoms of attention deficit and hyperactivity (Piek et al., 2007; Rasmussen & Gillberg, 2000).

The research findings on the connection between motor skills and peer and social problems show less agreement than the above-mentioned studies on motor skills and emotional well-being. Some studies have found that children and adolescents with poor motor skills have fewer playmates (Schoemaker & Kalverboer, 1994), fewer social spare time activities (Cantell, Smyth, & Ahonen, 1994) and spend less time on social activities (Bouffard, Watkinson, Thompson, Causgrove Dunn, & Romanow, 1996). However, poor motor skills have not been reported to co-occur with negative social contacts such as physical violence, fighting and verbal abuse (Piek, Barrett, Allen, Jones, & Louise, 2005; Smyth & Anderson, 2000). In sum, the previous research suggests an association between motor skills and several indicators of psychosocial well-being, which can be defined in various ways

depending on the context and theoretical approach. In the present study we define it as encompassing the ability to regulate one's emotions and behavior in social contexts and to maintain social relationships.

The main purpose of this study is to explore the connections between self-concept, motor skills and psychosocial well-being among girls. Self-perceptions, and its derivatives such as self-concept, self-esteem or self-worth, influence psychosocial well-being. In correlational studies of motor skills, for example, self-worth, defined as how people value themselves, has been connected to emotional problems in children with poor motor skills (i.e., anxiety and depression: Piek et al., 2005; Rose, Larkin, & Berger, 1997; Schoemaker & Kalverboer, 1994; Skinner & Piek, 2001). However, owing to their designs, the previous studies on children and adolescents with poor motor skills do not permit causal inferences. Nevertheless, evidence is beginning to accumulate showing that, in adolescence, self-concept might play a significant mediational role in how perceived motor skills influence social and emotional well-being, specifically anxiety and depression (Rigoli, Piek, & Kane, 2012). Although the study conducted by Rigoli and colleagues used a normative sample, the need remains for large population-based studies connecting motor skills, self-concept and psychosocial well-being. Furthermore, in the studies referred to above, the multidimensionality of the self-concept, in which global self-perception can be separated from domain-specific self-perceptions (Harter, 1999; Marsh & MacDonald Holmes, 1990), has not been of focal interest.

It has been suggested that domain-specific self-concepts follow different routes to psychosocial well-being (Harter, 1999). In her model, Harter showed that both physical and academic self-concepts were connected to powerful emotional reactions, such as depression or hopelessness, together with general self-worth. In other words, domain-specific self-concepts have their own and separate relevance to psychosocial well-being. Moreover, it is

known that the role of academic self-concept is more complex for learning-disabled children than normal populations: more specifically, in such children, different areas of academic achievement and general intelligence are separated from each other (Harter, 1999). Therefore, it is obvious that academic self-concept should be studied separately in relevant school subjects (for a review, see Marsh & MacDonald Holmes, 1990). Interestingly, it has also been proposed that academic self-concept should be divided into a verbal and a math self-concept (Marsh & MacDonald Holmes, 1990). In light of these findings, it is evident that it would be fruitful to study physical, verbal and math self-concepts separately. The above comments on the previous research indicate that research focusing, in particular, on the mediator role of the academic self-concept between motor skills and psychosocial well-being is lacking.

In the present study, we limited our investigation to adolescent girls for several reasons. In adolescence, psychosocial problems tend to rise in frequency (Smith & Rutter, 1995), and symptoms of depression and anxiety are more common among adolescent girls than among boys (e.g. Hankin et al., 1998). We also noticed that in the previous studies boys have often been overrepresented in the literature (e.g. Dewey, et al., 2002; Fliers et al., 2008; Rigoli, et al., 2012). Furthermore, based on the previous studies, which have reported various gender differences, e.g. in the factors that predict psychosocial well-being (Kapi, Veltsista, Kavadias, Lekea, & Bakoula, 2007; Myklestad, Røysamb, & Tambs, 2012), in the achievement of motor skills (e.g. Barnet, van Beurden, Morgan, Brooks & Beard, 2010; Mickle, Munro & Steele, 2011) and in self-perception levels (e.g. Hagger, Stuart, Biddle, & Wang, 2005; Piek, Baynam, & Barrett, 2006; Wilgenbusch & Merrell, 1999), a focus on one gender would give a clearer and more detailed picture of the associations in a rather neglected research area.

In sum, based on the current literature, it can be suggested that motor skills, self-concept and psychosocial well-being are intertwined. However, the existing studies offer us

only a limited understanding of the interconnections between these concepts. Although cross-sectional data cannot explain causal relations, such data can be used in structural equation models to show the simultaneous associations between variables and to test the directional trends of those associations. Therefore, in this cross-sectional study, we investigated whether the self-concepts of physical education, reading and mathematical ability mediate the relationship between motor skills and psychosocial well-being in adolescence in a population-based sample. On the basis of the existing knowledge (Rigoli et al., 2012), we constructed a hypothetical model (Figure 1) of the relation between motor skills and psychosocial well-being in which the school-related self-concepts occupy a mediator role. In this mediational study, we tested six associations: three associations between motor skills and the school-related self-concepts (SC: physical education, reading and math), and three associations between the school related SCs and psychosocial well-being.

Figure 1 here

## **Methods**

### **Participants and procedure**

The study sample consisted of a middle-school cohort of girls. The study was carried out in a typical middle-sized Finnish municipality (pop. 20 000). Two-thirds of the participants lived in the urban center and 33.6 % in the surrounding rural area. A total of 327 female students from grades 7–9 participated in the study. Of these, 109 were in the 7<sup>th</sup>, 99 in the 8<sup>th</sup> and 119 in the 9<sup>th</sup> grade. Only one student refused to participate in the study. The age range was between 12 and 16 years. After obtaining permission from the municipal school board and the principals of all three schools, students filled out questionnaires anonymously



during a one-hour lesson. The students were supervised by teachers who, also collected the questionnaires and returned them to the researchers.

## **Measurements**

**Psychosocial well-being.** Psychosocial well-being was measured by the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1998), which is a brief behavioral screening instrument for emotional and behavioral problems. However, it has also been reported to be a valid measure of psychosocial well-being (Tsang, Wong, Lo, 2012). In this study, the Finnish Youth Self Report version of the SDQ was used. This version has been found to have good psychometric properties in a large Finnish population-based study (Koskelainen, Sourander, & Kaljonen, 2000). The self-report version is designed for youth aged 11–16 and consists of 25 items scored 0 for “not true”, 1 for “somewhat true” and 2 for “certainly true”. The items comprise 5 subscales: hyperactivity, emotional symptoms, conduct problems, peer problems and prosocial behavior. Each subscale contains 5 items. Each subscale was treated in the analysis as a separate subscale.

**School-related self-concepts.** School-related self-concepts were /assessed with the Self-Concept of Ability scale (Nicholls, 1978) adapted for use in Finland by Aunola and colleagues (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002). In this self-report questionnaire, students evaluate their ability to perform in a given school subject compared to their peers. In this study they evaluated their academic self-concept in three school subjects: physical education, reading, and mathematics. These school subjects were chosen, because problems in them are known to coexist with poor motor skills (e.g. Fliers et al., 2008; Gillberg et al., 2004; Kaplan et al., 1998; Martin et al., 2010; Westendorp et al., 2011). In order to assess school-related self-concept in each of the three subjects, the participants were

presented with a sheet of paper showing 20 circles in a vertical row. The circles represented the students in the respondent's classroom. The circle at the top represented the student who was best at the subject of interest, i.e., physical education, reading, or mathematics, and the bottom circle the student with the weakest performance. Students were asked to put a cross in the circle that best indicated their own abilities. All three self-concepts were analyzed separately.

**Motor skills.** In the interests of cost-effectiveness, a self-report adolescent version of the well-known DCDQ (Developmental Coordination Disorder Questionnaire; Wilson, Kaplan, Crawford, Campbell, & Dewey, 2000) was chosen. In a pilot study, Cantell, Crawford, and Doyle-Baker (2008) reported reasonable concurrent validity with a standardized motor test, the Movement ABC 4+ ( $r = .318$ ,  $p = .001$ ). The original DCDQ is widely used in motor skill screening in 5- to 12-year-old children and has sufficient psychometric properties (Schoemaker et al., 2006). This self-report adolescent version of the DCDQ was translated into Finnish.

The Adolescent DCDQ, in common with the original version, provided information on everyday motor skills and took about 10 minutes to complete. It comprised of 17 items, with categories similar to those of the original DCDQ: control during movement, fine motor control and general coordination. Each item took the form of a statement, e.g., "I can throw a ball in a controlled and accurate fashion." The adolescents responded to the statements on a scale of 1 to 5, where 1 = "not at all like me", and 5 = "very much like me."

### **Statistical Analysis**

In the first phase, the measurement model of the Adolescent DCDQ was tested with confirmatory factor analysis using Mplus, version 6 (Muthén & Muthén, 1998–2010). The

model estimation method was WLSMV (mean and variance weighted least square) and the missing data method was used to allow the inclusion of all the observations in the data set. The factor scores were saved and used in the further analysis.

In the second phase, the associations between motor skills and psychosocial well-being were analyzed with self-concept as a mediator. The analyses were performed using structural equation modeling with the Mplus program, version 6 (Muthén & Muthén, 1998-2010). The few missing values (covariance coverage for the girls was at least 97.9 percent) were assumed to be missing at random, and therefore the full information maximum likelihood estimation with robust standard errors was used. The hypothesized structural model, shown in Figure 1, depicts the relationships between motor skills and psychosocial well-being, with self-concept as a mediator variable. Correlations between the three self-concept variables (SCPE, SCR, SCM) were not allowed. All non-significant paths ( $|t| < 2.0$ ) were excluded from the Figure 2.

In order to evaluate the degree to which the models (confirmatory factor model and structural equation model) were consistent with observed data, the following goodness-of-fit measures were used: chi-square ( $\chi^2$ ), root mean square error of approximation (RMSEA), standardized root mean square residuals (SRMR), Tucker-Lewis index (TLI), and comparative fit index (CFI). It is accepted that values smaller than .06 for RMSEA and .08 for the SRMR (Hu & Bentler, 1999), and values higher than .95 for both the TFI and the CFI indicate that the model fits the data well (Hu & Bentler, 1999).

## **Results**

In this mediational study we tested six associations, three of them between motor skills and school-related self-concepts and three between psychosocial well-being and school-related self-concepts. In the first phase of the analysis, the goal was to test the theoretical

measurement structure of the Adolescent DCDQ (Wilson et al., 2000). The data (N=327) showed only a few missing values and covariance coverage ranged from .957 to 1.0. However, the theoretical unconstrained three-factor model did not fit the data well. Exclusion of the original items was based on the standardized factor loadings (four items with a loading lower than .3 were deleted from the model); furthermore, one item had a high residual correlation with another item ( $r=.56$ ). The final model consisted of three factors (control during movement, CDM; fine motor control, FM; general coordination, GC) each with four items and fitted the data well,  $\chi^2(32)=68.41$ ,  $p<.05$ , CFI=.99, TLI=.99, RMSEA=.041, WRMR=.70. The standardized loadings varied between .50 and .90. Table 1 shows the content of the three-factor solution of the Adolescent DCDQ after confirmatory factor analysis and the standardized factor loadings.

Table 1 here

Figure 2 here

In the second phase of the analysis, the relationships between motor skills and psychosocial well-being, with school related self-concept of ability as a mediator variable, were investigated using mediation analysis (Figure 2). The coefficients are from the standardized solution, where standardization means that the total variance of the factors and observed variables are equal to 1.

First, a second order latent factor, named motor skills, was formed. As in the original DCDQ, this latent factor consisted of three factors: control during movement (CDM:  $\lambda=.70$ ), fine motor control (FM:  $\lambda=.58$ ) and general coordination (GC:  $\lambda=.88$ ). Further, three specific factors, one for each of these latent motor factors, were added to the model, thereby capturing

the residual variance. These specific factors were control during movement ( $\lambda=.71$ ), fine motor control ( $\lambda=.58$ ), and general coordination ( $\lambda=.47$ ). On the basis of the modification indices, two associations were also included. Correlations were found between the specific control during movement and specific fine motor control factors ( $r=.69$ ), and between the specific control during movement and specific general coordination factors ( $r=.35$ ).

Second, due to the high correlation between all five SDQ subscales, a psychosocial well-being latent factor for the SDQ subscales was formed (Figure 2). Conduct problems ( $\lambda=.93$ ) and hyperactivity ( $\lambda=.59$ ) had the highest loadings with psychosocial well-being. There were also two residual correlations: between the prosocial and emotional behavior composite scores ( $r=.23$ ,  $p<.001$ ), and between the peer relations and emotional behavior composite scores ( $r=.29$ ,  $p<.001$ ).

The final structural mediation model is presented in Figure 2. In the interests of clarity, only significant standardized loading values that were higher or equal to  $|.20|$  are reported in the figure. However, all the other statistically significant associations are reported in Table 2 together with the residual variances of the self-concepts and SDQ subscales. The final model showed a good fit:  $\chi^2(31)=19.70$ ,  $p=.94$ ; RMSEA=1.00; SRMR=.021; TLI=1.02; CFI=1.00.

Table 2 here

The mediation model established two kinds of associations: mediational and direct associations. Indirect associations between motor skills and the SDQ subscales were found with school-related self-concept as a mediator. In these associations, the combination of poor motor skills and more problems in psychosocial well-being was mediated by poor school-related self-concept. The strongest mediational association was established between motor

skills, school-related self-concept of physical education (SCPE), and peer relations. All the other weaker but significant associations are reported in Table 2.

Direct associations also emerged between motor skills and psychosocial well-being, both of which were added to the model on the basis of the modification indices. The association between motor skills and psychosocial well-being was negative and very strong ( $\gamma = -.66$ ), indicating that good motor skills were associated with high psychosocial well-being while poor motor skills were associated with poor psychosocial well-being. All the other direct associations were weaker and are reported in Table 2. We also found that the variance of motor skills with the three school-related self-concepts explained the variances of psychosocial well-being (44%), conduct problems (65 %), hyperactivity (42 %), and emotional problems (31 %) (Figure 2).

## **Discussion**

In this study, we were interested in the interconnections between motor skills and psychosocial well-being in girls. The relevance of self-concept as a mediator between motor skills and psychosocial well-being has only recently begun to be studied (Rigoli et al., 2012). Based on the previous studies (Piek et al., 2005; Rigoli et al., 2012; Rose, et al., 1997; Schoemaker & Kalverboer, 1994; Skinner & Piek, 2001), we hypothesized that school-related self-concepts have a mediating role between motor skills and psychosocial well-being; this hypothesis was partially supported by our results. Our main finding was that the school-related self-concepts only mediated the association between motor skills and peer problems. The direct association from motor skills to psychosocial well-being was stronger than that found for the mediators, suggesting that there is also a foundational link between self-perceived motor skills and well-being.

The strong direct association between motor skills and the subdomains of psychosocial well-being could reflect the fact that in previous studies (e.g., Bouffard et al., 1996; Cantell et al., 1994; Piek et al., 2008) aspects of psychosocial well-being have mainly been investigated in isolation from each other, and hence the power of their possible associations has not been of focal interest. In our study, we searched for a deeper understanding of the interconnections of several aspects of psychosocial well-being and their associations with motor skills and domain-specific self-concepts. We found that, among girls, motor skills explain 44 % of psychosocial well-being, which is in line with the finding of Rigoli and colleagues (45 %; 2012), whose study included both boys and girls. These results show that motor skills are an important factor for adolescents' psychosocial well-being, and therefore, motor skills should be supported to ensure better health in adolescents. As motor skills and physical activity are intertwined, improving motor skills may also increase the level of physical activity, and so further promote psychosocial well-being. Therefore, we recommend evaluation of female adolescents' perceptions of their motor skills to better understand overall well-being, especially among females with poor psychosocial well-being.

Motor skills and school-related self-concepts in our study explained three psychosocial variables: conduct problems (65 %), hyperactivity (42 %), and emotional problems (31 %). Interestingly, however, in previous studies on children and adolescent with motor problems, the connection to psychosocial variables such as conduct problems has been somewhat weaker (Dewey, Kaplan, Crawford, & Wilson, 2002; Green et al., 2006) or even non-existent (Chen, Tseng, Hu, & Cermak, 2009). It should, however, be noted that, unlike the present study on adolescent girls, these studies have used younger participants, focused on poor motor skills, and included both genders. However, Rose and colleagues (1997) found that well-coordinated girls, in particular, were more satisfied with their behavioral conduct than the other participants. Nevertheless, in normative samples, self-evaluated motor skills and

conduct problems have not, to our knowledge, been studied together. On the one hand, physical inactivity has been found to be a risk factor for conduct problems (Monshouwer, ten Have, van Poppel, Kemper, & Vollebergh, 2009), while, on the other hand, a high level of formal sport participation was associated with low levels of externalizing, social, aggression, and delinquency problems (Donaldson & Ronan, 2006). Furthermore, Donaldson and Ronan found self-perceived motor skills, in particular, to be a more relevant indicator of psychosocial well-being than externally assessed skills. Therefore, our findings are in line with those of previous studies with respect to the relationship between high motor skills and no behavioral problems. It has been suggested that physically active and sport environments provide socialization opportunities and a site for rehearsing adaptive behaviors, such as cooperation, unselfishness, stress management and the ability to tolerate frustration, which are needed in everyday life (Smith & Smoll, 1997). The high relevance of conduct problems for psychosocial well-being in our study could also be explained by their importance for girls' mental health, especially in the school context (Myklestad et al., 2012). An alternative reason for the high explanation rate of conduct problems could be that the items comprising conduct problems are sensitive to aspects included in other psychosocial well-being subdomains. In other words, conduct problems might also reflect, for example, hyperactivity or emotional ill- or well-being.

Closer inspection revealed strong associations between motor skills and school-related self-concept of physical education and mathematics. Self-concept in physical education had the strongest association with the socially oriented subscales of psychosocial well-being, especially peer problems. This means that those who have good motor skills also consider that they do well in physical education classes and have good peer relations and fewer emotional problems. Although connections between motor skills and social competence (Cummins, Piek, & Dyck, 2005; Bouffard et al., 1996; Cantell et al., 1994; Schoemaker &



Kalverboer, 1994) and between motor skills and emotional problems (Piek et al., 2005; Rose et al., 1997; Schoemaker & Kalverboer, 1994; Skinner & Piek, 2001) have consistently been reported, the role of school-related self-concept has been less studied. Furthermore, the studies reported so far have not measured motor skills, self-concept and psychosocial well-being simultaneously. Harter (1999), however, provides some support for our finding, suggesting that physical competence has a strong relationship to peer relations and emotional problems, i.e., physically competent persons receive more approval from their peers, which is further connected to their psychosocial well-being, especially emotions.

In contrast to previous findings on the relationship between self-concept and psychosocial well-being, we found that the school-related self-concepts of reading and mathematics were only weakly associated with psychosocial well-being. Previously, Harter (1999) and Marsh and his colleagues (1988) have suggested that academic self-concept should be studied separately in different school subjects, and further, that physical and academic self-concepts each have their own connections to behavioral problems (Harter, 1999). Recently, however, Rigoli and colleagues (2012) employed a multidimensional self-concept measure and found no unique associations between the subareas of self-concept and emotional problems. In contrast to our study, they found self-concept to be a strong mediator between motor coordination and emotional problems. This might be caused by the differences in the self-concept measures used and how they were operationalized in the statistical analysis. The Self-Description Questionnaire (Marsh, 1992), used by Rigoli and colleagues (2012), measures self-perceptions more broadly as it also includes other perceptions, e.g. parent relations and same-gender peer relations, than simply academic and physical self-concepts, whereas our measure focused specifically on school-related self-concepts in three school subjects. Further, in contrast to the measure used in the present study, which included three separate school-related self-concepts, Rigoli and colleagues

constructed a latent self-perceptions factor based on the subscales of the measure, which may strengthen the power of the latent factor.

Our sample was a representative sample of three age cohorts in a typical middle-size Finnish town, which gave us a wide perspective on the connections between motor skills and psychosocial well-being. However, that fact that Finland is a small country, could be seen as a limitation on the generalizability of the findings. Furthermore, unlike the school systems in many other countries, in Finland education is compulsory for nine years starting in the year of the child's seventh birthday. In practice, this means that schools offer a similar education all over the country; consequently, we consider the sample to be both representative and of sufficient size to allow generalization to the general population of Finland.

Further, the large sample size enabled us to examine the mediator role of school-related self-concept for psychosocial well-being. However, as with any large scale study, ours has its limitations. For example, we used self-reports, which despite their known limitations are often the only cost-effective method of data collection. In this study, therefore, it can be argued whether, as measures, self-reported motor skills matches school-related self-concept of physical education. In the self-concept measures, perceptions of motor competence are often general: "I do well at all sports" (Perceived Competence Scale for Children; Harter, 1982) or "I enjoy sports and physical activities" (Self Description Questionnaire III; Marsh & O'Neill, 1984). The general coordination section of the Adolescent DCDQ also contains similar kinds of general statements, i.e., four items described e.g., general competence in sport or ability to learn new motor skills. However, the majority of the statements (eight items) were more specific statements about a given motor skill, e.g. "I throw a ball in a controlled and accurate fashion, compared to other teens." Moreover, it has been suggested that adolescents are rather accurate in evaluating their own motor skills (McKiddie & Maynard, 1997). It would also seem that in adolescence, self-perceptions of skills are more

relevant for psychosocial well-being than objectively measured skills (Donaldson & Ronan, 2006). That is, well-being is dependent on the individual's ability to discount the value of skills that they are not so good at (Harter, 1999).

However, in the future there is a need for longitudinal studies to strengthen our understanding of the factors related to causality between motor skills, self-concept and psychosocial well-being. Furthermore, psychosocial well-being is a large concept that includes a variety of aspects not included in this study (see review e.g. Tsang et al., 2012). In our study the viewpoint was "problem-oriented" and other resiliency factors such as self-management, affective strength or goal-directed behavior were not studied. Therefore, our knowledge about these protective or buffering factors is limited, and research also needs to be targeted at these aspects. There is also a need for studies which examine possible contrasting interactions, i.e., whether psychosocial well-being has causal relations with motor skills. Finally, we need studies that focus on the interaction between motor skills, self-concept and psychosocial well-being in boys as well as girls.

To summarize, according to our findings, the associations between motor skills and psychosocial well-being are complex and are based on both direct and mediational associations. However, motor skills can be considered a not particularly well-known, yet promising, indicator of female adolescents' psychosocial well-being. Motor skills are a relevant factor to consider when planning actions to support adolescents' overall well-being. In many countries physical education, the purpose of which is to enhance motor skills and physical activity, is an obligatory subject in schools. Therefore, physical education could have an important role in promoting girls' psychosocial well-being and mental health in adolescence; during which there is a risk for increased psychosocial ill-being (Smith & Rutter, 1995).

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Table 1. Content of the Adolescent DCDQ of the three-factor solution after confirmatory factor analysis and the standardized factor loadings

Control During Movement		Fine Motor Control		General Coordination	
1. Throws ball	.81	5. Writing fast	.63	9. Team sports	.57
2. Catches ball	.86	6. Writing legibly	.60	10. Avoid sports	.72
3. Hits ball	.77	7. Effort and pressure	.60	11. Learning motor skills	.63
4. Jumps over	.69	8. Cuts	.90	12. Fatigues easily	.51

Table 2. Residual variances (Res. var.) of the self-concepts and the SDQ subscales and significant standardized loading values below  $|.20|$  not shown in the figures

	Res. var.	S-FM	S-GC	SCPE	SCR	SCM
SCPE	.51	.12				
SCR	.75					
SCM	.57					
Prosocial beh.	.75					
Peer prob.	.88		-.14			
Hyperactivity	.58					.14
Conduct prob.	.35				.12	
Emotional prob.	.69			.17		

SCPE = self-concept in physical education, SCR = self-concept in reading, SCM = self-concept in mathematics

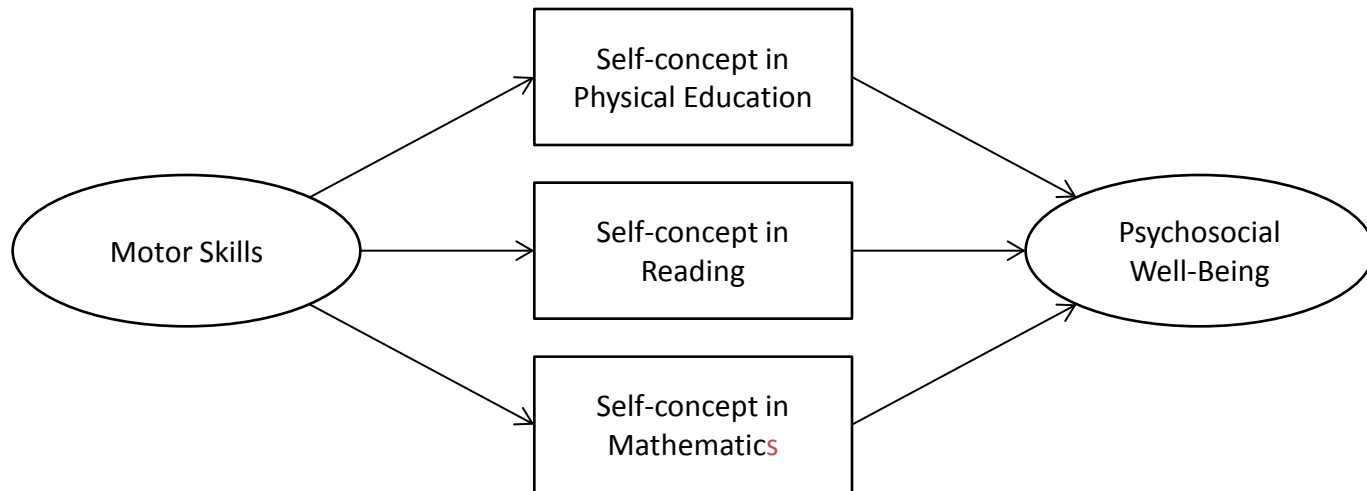


Figure 1. The hypothetical mediator model of the associations between motor skills and psychosocial well-being

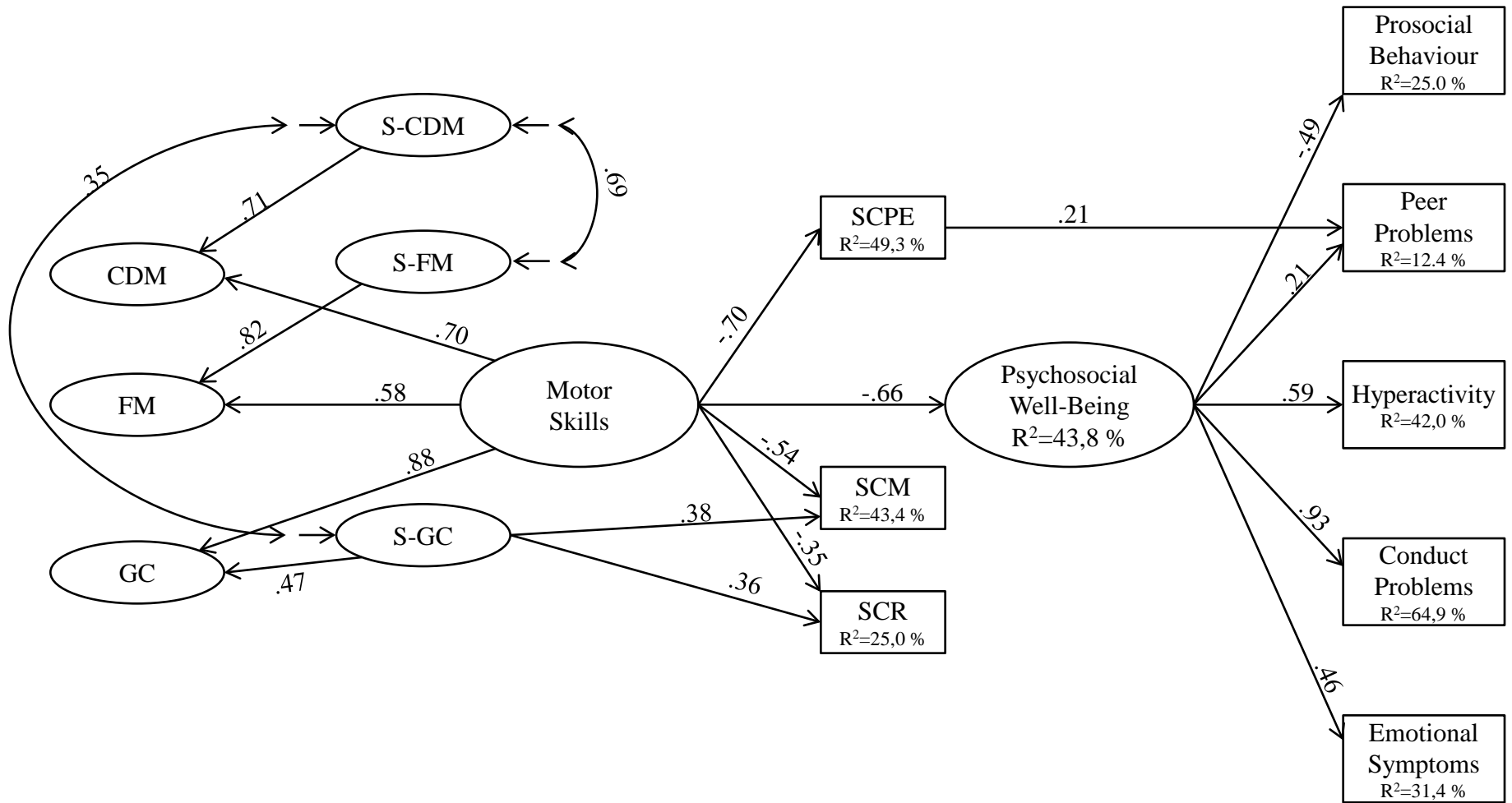


Figure 2. The final model, loadings below  $|\ .20 |$  excluded

Note: CDM=control during movement, FM=fine motor control, GC=general coordination, S- = special factor for, SCPE=self-concept in physical education, SCM=self-concept in reading, SCR=self-concept in mathematics