Int J of Sci and Math Educ (2017) 15:817–836
DOI 10.1007/s10763-016-9717-y

Science vs. Sports: Motivation and Self-concepts of Participants in Different School Competitions

Tim Niclas Höffler[1] · **Victoria Bonin**[1] · **Ilka Parchmann**[1]

Received: 5 November 2015 / Accepted: 3 February 2016 / Published online: 1 March 2016

Abstract Competitions are discussed as a measure to foster students' interest, especially for highly gifted and talented students. In the current study, participants of a cognitive school competition in science were compared to non-participants of the same age group (14–15) who either did not participate in any competition or who participated in a non-cognitive sports competition. The study focused on goal orientations and competence beliefs and analyzed outcomes as a foundation for further improvements of enrichment measures and competitions with regard to fostering students' interest especially in science. The results showed considerable differences (and some unexpected similarities) between groups: Science competition participants were more learning goal oriented, had less performance avoidance goals, and showed less work avoidance than non-participants. Social self-concept was higher but was moderated by GPA. Considerable gender differences were found as well. These findings are discussed with regard to further research and possibilities for improvement of science competitions.

Keywords Self-concept · Goal orientations · Gender · Competitions · Motivation

The need of raising interest in STEM fields for more gifted and talented young students has been stated repeatedly (Krapp & Prenzel, 2011; Organisation for Economic Cooperation and Development, 2008; Osborne, Simon, & Collins, 2003). As a consequence, a number of different measures have been developed and implemented to enrich school education. Enrichment can be defined as "the provision of in-depth multidisciplinary exploration of content beyond that provided in the regular curriculum" (Nebraska

Electronic supplementary material The online version of this article (doi:10.1007/s10763-016-9717-y) contains supplementary material, which is available to authorized users.

✉ Tim Niclas Höffler
hoeffler@ipn.uni-kiel.de

[1] IPN, Kiel, Germany

Department of Education, 1997, p. 32) with the goal to further develop gifted learners (Taber, 2007). Enrichment can take place inside schools, for example by forming groups of gifted learners to tackle specific issues or projects, or outside schools, such as in science labs, summer schools, or science competitions (UK Department for Education and Skills, 2002, as cited in Taber, 2007). Science competitions often pursue the same goals as enrichment measures in stimulating "students to expand their talents, and to promote science as a career" (Lim & Oliver, 2015, p. 5). While they therefore could be regarded as enrichment measures (Taber, 2007), this is usually not the case in the USA. In this paper, we focus on competitions but refer to enrichment measures in a broader sense as well.

Unfortunately, only few studies have investigated the actual effects of enrichment measures and competitions yet and even fewer have found clear effects (e.g. Bazler, Spokane, Ballard, & Fugate, 1993; Stake & Mares, 2001). Competitions, for example, have the potential to raise the self-perception of successful students and to produce positive consequences for career contributions (cf. Tirri & Nokelainen, 2010) but might decrease interest in any further scientific activities for non-successful participants (cf. Deci & Ryan, 2000). On the other hand, experiencing success in comparison with other interested and engaged students could raise the self-concept in a more efficient way than school science—which has been pointed out as a problem especially for girls (e.g. Köller, Daniels, Schnabel, & Baumert, 2000; Marsh & Yeung, 1997).

Goal orientations and self-concept have been highlighted as important variables for motivation and choice (e.g. Köller et al., 2000; Spinath & Steinmayr, 2012). However, their influence on participating in different enrichment measures and competitions is unclear; how do self-concept and goal orientations interact with the competitions' overarching goal to foster interest in the STEM field? How do participants of competitions differ from non-participants? Therefore, the current study aims to investigate goal orientation and self-concept of participants in a science competition in comparison to non-participants. As non-participants, two groups were chosen: normal school classes and participants of a different, non-cognitive competition, in this case a sports competition. The latter was added to investigate whether the situation of a competition independent of its focus correlates with specific features of motivation and self-concept or whether these might be different only for the cognitive science competition.

Theory and Current Research

Competence Beliefs: Self-concept

Competence beliefs are often defined as cognitive representations of one's own ability level (e.g. Spinath & Steinmayr, 2012), that is, self-concept. Self-concept is a multidimensional construct and is generally regarded as a personality trait with an additional self-evaluative element (Shavelson, Hubner, & Stanton, 1976). Following this model, the general self-concept is hierarchically structured into several subgroups (academic, social, emotional, and physical self-concept). Of those, the academic self-concept is the one which has received most attention in educational research, as it reflects the cognitive representations of one's abilities regarding academic performance (e.g. Marsh, 2004). It is generally regarded as a major factor influencing learning and intrinsic motivation (Spinath & Steinmayr, 2012).

One's self-evaluation of competences often refers to specific reference standards and comparisons (Heckhausen & Leppmann, 1991). These comparisons are crucial for the academic self-concept (Marsh, Trautwein, Lüdtke, & Köller, 2008). For instance, a well-established effect of social references is the big-fish-little-pond (BFLP) effect (Marsh, 2005): The mean achievement level of, for example, fellow students (the "external frame of reference"; cf. internal/external frame of reference model, I/E model; Marsh, 1986) can have a significant effect on the individual self-concept. Equally able students may develop different academic self-concepts depending on the academic abilities of their fellow students (the external frame of reference). If "the pond is small" (i.e. the average ability level of the school's students is rather low), then an average-ability student will use this reference for social comparison with the likely result that (s)he will develop a high academic self-concept (Marsh, 2005). If the same student was in a class with more able students than herself/himself, a significantly lower self-concept would likely be the result (Marsh et al., 2008).

The abovementioned I/E model of reference (Marsh, 1986) explains a further subcategorization of academic self-concepts into subject-specific academic self-concepts (i.e. mathematics, science, history). Both social comparisons (external frame of reference) and intra-individual comparisons (internal frame of reference) between individual competences in different subjects are important in this model. "Hence, academic self-concepts depend not only on a student's academic accomplishments but also the accomplishments of those in the school that the student attends" (Marsh, 2005, p. 120).

Self-concept is considered to have a crucial impact on psychological well-being; thus, establishing and strengthening the self-concept is an important educational goal (Bracken, 1996; Wylie 1979). A positive correlation between positive academic self-concept and good performance has repeatedly been shown (e.g. Marsh, Kong, & Hau, 2001; Marsh & Yeung, 1997; Plucker & Stocking, 2001). Möller and Köller (2004) reported in their review 34 different studies with consistently positive and substantial correlations between performance and self-concepts. Additionally, prior self-concept can affect subsequent interest, school grades, and standardized test scores but is itself affected by interest only to a small degree (Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). Furthermore, self-concept can be used to successfully predict coursework selection in school (Marsh & Yeung, 1997).

Self-concept differentiates and stabilizes with increasing age (Shavelson et al., 1976) and is especially affected by crucial events like the transition from elementary school to high school (Aust, Watermann, & Grube, 2010). Lastly, self-concept is correlated with gender. Often, boys were found to have a higher academic self-concept in mathematics (Meece, Wigfield, & Eccles, 1990) and science (Blankenburg, Höffler, & Parchmann, 2015; Wilkins, 2004) while girls' academic self-concept in languages was superior (Crain, 1996; Köller et al., 2000; Marsh & Yeung, 1997), which coincides with typical interest distributions between girls and boys (Baumert & Köller, 1998). However, the magnitude of those gender gaps differs across the world (Wilkins, 2004).

Goal Orientation

Besides competence beliefs, achievement motivation is an important determinant of effort and therefore considered a crucial element for learning (e.g. Meece, Anderman,

& Anderman, 2006; Spinath & Steinmayr, 2012). Individuals' different goals can explain achievement motivation to a considerable degree (e.g. Ames 1992; Grant & Dweck, 2003; Nicholls, 1984). The original differentiation of achievement goals in two categories (e.g. Ames, 1992; Dweck & Sorich, 1999)—learning goals (sometimes referred to as mastery goals) and performance goals (sometimes referred to as ability goals)—has seen a further subdivision (e.g. Elliot & Harackiewicz, 1996). Nowadays, most researchers refer to four different goals: (1) *Performance approach goals* refer to a focus on attaining success and demonstrating ability, (2) *performance avoidance goals* are characterized by the aspiration not to demonstrate incompetence (Elliot & Church, 1997), (3) *learning goals* refer to the acquirement of new skills or knowledge (Grant & Dweck, 2003), and (4) *work avoidance* (Nicholls, 1984) represents the aim to avoid or minimize effort in achievement-related tasks (Wirthwein, Sparfeldt, Pinquart, Wegerer, & Steinmayr, 2013). It is important to note that those goals are not mutually exclusive and can vary, for example, within students from school subject to school subject (e.g. Sparfeldt, Buch, Wirthwein, & Rost, 2007) or between different science activities (Meece, Blumenfeld, & Hoyle, 1988).

Learning goals can successfully be used to predict, among others, student's well-being (Ames & Archer, 1988; Kaplan & Maehr, 1999) as well as grades and test scores (e.g. Greene & Miller, 1996; Midgley & Urdan, 1995). Usually, no direct path was found but, for example, a positive influence of learning goals on meaningful cognitive engagement, which in turn was associated with better test scores (Greene & Miller, 1996). Conversely, performance goals were found to predict academic self-handicapping (i.e. procrastinating and deliberately not trying), which is negatively correlated with GPA (Midgley & Urdan, 1995). However, Kaplan and Maehr (1999) identified learning goals to be directly associated with well-being and GPA, whereas holding performance goals was a significant negative predictor for some measurements of well-being. As performance goals emphasize outcomes as ability measures, they are more likely to lead to helplessness after a negative feedback (Grant & Dweck, 2003). Learning goals, on the other hand, "were shown to facilitate persistence and mastery-oriented behaviors in the face of obstacles, even when perceptions of current ability might be low" (Grant & Dweck, 2003, p. 541). Learning goals are associated with a more active cognitive examination of the learning matter, a higher intrinsic motivation (Meece et al., 1988), as well as better perseverance (Ames & Archer, 1988). Generally speaking, girls are more likely to have learning goals while boys often score higher on scales regarding performance goals and work avoidance (e.g. Freudenthaler, Spinath, & Neubauer, 2008; Patrick, Ryan, & Pintrich, 1999).

Competitions, Enrichment, and Their Relation with Motivation and Self-concept

In general, out-of-school enrichment measures and competitions aim—in addition to the development of students' skills and abilities—to motivate and interest students for the field or to maintain their motivation, respectively (Lim & Oliver, 2015; Stake & Mares, 2001).

Furthermore, enrichment measures and competitions usually aim to develop or maintain students' competence beliefs (i.e. self-concept; e.g. Vogl & Preckel, 2014). While the effect on (cognitive) abilities and skills has repeatedly been shown (e.g. Kulik & Kulik, 1984; Reis & Renzulli, 2010; VanTassel-Baska & Kulieke, 1987), the effect on affective measures is less certain (Stake & Mares, 2001). While sometimes rather strong effects on motivation and self-concept could be shown (e.g. Olszewski-Kubilius, 1997), the effect on interest, for example, was often less strong or non-existent (Bazler et al., 1993; Freedman, 1997; Houtz, 1995; VanTassel-Baska & Kulieke, 1987). Stake and Mares (2001) showed some indication for a positive effect of a program for gifted students on subjective ratings of science attitude changes, even though they did not find significant pre-post differences on science attitude itself. Mokhonko, Nickolaus, and Windaus (2014) found only small effects on students' self-concept who participated in out-of-school labs. On top of that, those effects disappeared in the follow-up test. Even though talented students are generally expected to have higher academic self-concepts, Marsh, Chessor, Craven and Roche (1995) reported the results of two studies in which they found even negative effects of enrichment on participants' self-concept as a result of the BFLP effect. Likewise, Craven, Marsh, and Print (2000) as well as Coleman and Fults (1982) found selective measures of enrichment programs to have a negative influence on participants' self-concept. Concerning the relation of motivation and *competitions*, specifically, even less is known. Tauer and Harackiewicz (1999) could show, for instance, that achievement motivation plays an important role in competitive conditions as a moderator for success. Urhahne, Ho, Parchmann, and Nick (2012) searched in their analysis for predictors for reaching later stages of the International Chemistry Olympiad (IChO). Qualified participants had, among other factors, a higher expectancy of success and less fear of failure.

Research Goals

The main goal of this study was to compare academic self-concepts and goal orientations (as aspects of motivation) of participants in a science competition with non-participants of the same age group (14–15), represented by normal school classes and participants of another, non-cognitive competition. The additional analysis of a second competition group enabled us to differentiate the possible overall influence of a competitive situation from a particular influence of the cognitive science competition.

The following research questions and hypotheses have been investigated:

1. In which way do participants' and non-participants' academic self-concepts differ?
   We expected higher self-concepts of participants even though the big-fish-little-pond effect might have had a counter-influence (being together with many other high-ability students during the competition might reduce their self-concept considerably; cf. Coleman and Fults 1982). However, effects were expected particularly for the more cognitive science competition.
2. How do goal orientations of participants of science competitions differ from those of non-participants or participants of another (sports) competition? As a participation in a competition usually requires additional effort, participants were expected to have lower work avoidance than non-participants. Additionally, participants should have less performance avoidance goals, as competitions have the inherent premise to try to exceed others, usually in public, which stands in contrast to a predisposition of concealing one's inabilities. Furthermore, participants of the sports competition were expected to have higher performance approach goals than

non-participants as well as participants of the science competition (cf. Tauer & Harackiewicz, 1999).

3. Which gender effects can be identified?

   We expected that boys would have higher science self-concepts than girls (cf. Meece et al., 1990), but that this effect is less strong among the competitions' participants—as those girls probably are well aware of their abilities. As to goal orientations, girls were expected to have stronger learning goals and to show less work avoidance (Freudenthaler et al., 2008; Patrick et al., 1999). Again, these differences are probably less pronounced in the participants group.

   Regarding the relations between all measured variables and the participation in either a sports competition (*Jugend trainiert für Olympia* (JtfO), see below) or a science competition (*International Junior Science Olympiad* (IJSO), see below), Fig. 1 shows our expectations (in terms of correlations) based on the theory reported above.

   Boys have generally a higher self-concept than girls, which explains our expectation of negative correlations between self-concepts and gender (as boys are coded with 0 and girls with 1). Moreover, participants in a science competition (such as IJSO, see below) as well as students with a better GPA should have a higher social self-concept. The same relations should hold true for learning goals (hence, also the expected positive correlation between both constructs). Performance goals as well as work avoidance are rather prevalent in boys as well as in students with lower GPA's (thus the expected negative correlations). Performance approach goals might play a role in participating in a sports competition (such as JtfO, see below), in which also less girls participate. Work avoidance should also be negatively correlated to self-concept and learning goals.

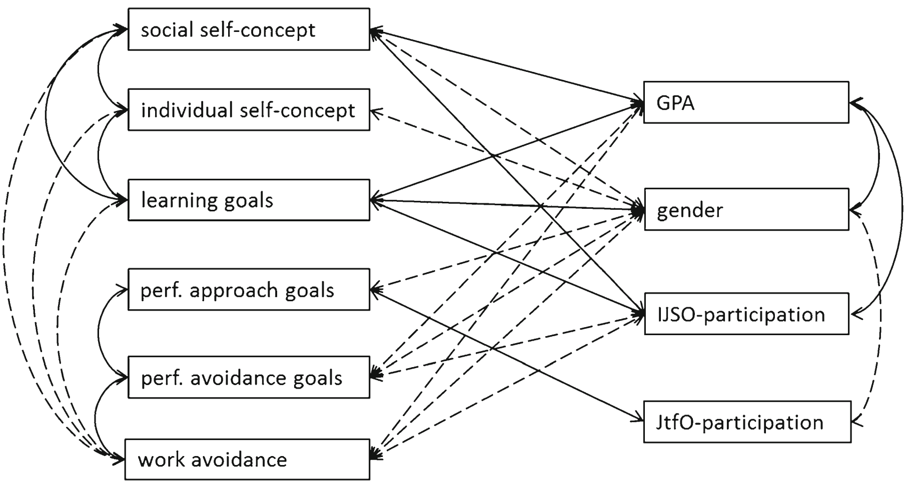

Fig. 1 Expected relations between all measured variables and the participation in either a sports competition (JtfO, see "Choice of Competitions" section) or a science competition (IJSO, see the same section). Participation in either competition (0 = no; 1 = yes) as well as gender (0 = male; 1 = female) were handled as categorical variables. For this analysis, GPA in terms of last grades in all school subjects was recoded so that larger values equal better performance. *Dashed lines* represent expected negative correlations; *continuous lines* represent expected positive correlations

Method

Choice of Competitions

For the purpose of this study, two vastly different, well-established competitions for students were chosen: the International Junior Science Olympiad and *Jugend trainiert für Olympia* (Young people training for the Olympic Games).

The International Junior Science Olympiad (IJSO) is an international science competition for students in which about 50 countries participate each year. It includes biology, chemistry, and physics and aims to promote students' interest in science as well as intercultural understanding. In Germany, the six team members of the international competition are chosen in a national competition over three rounds. From approximately 3500 students from the first round, only 500 students reach the second round and 45 the third round. The competition requires theoretical knowledge and experimental competences of the students. It is open for students not older than 15 years.

Jugend trainiert für Olympia (JtfO) has a 40-year-old tradition in Germany and aims to convey social values via sports. Equally important elements of this competition with approximately 800,000 participants each year are talent recruiting and talent development. The competition is held in 19 different sport disciplines. Over the course of up to four different rounds, the participants can qualify for the finals on the federal level. Children and teenagers between 8 and 19 may participate.

Participants

In the sample, $N = 574$ students were included (Table 1), among them are participants in the second round of the IJSO from all over Germany and participants of JtfO (75 % of them in the last or second-to-last round). Most of the latter had already participated at least twice (mean = 2.8 times). The other students were students of the same age group who neither participated in IJSO nor in JtfO (control group; *non-participants*). Those latter students were recruited as a convenience sample from three regular secondary schools with mostly urban catchment areas in northern Germany.

All sample subjects were students in the highest track of the German secondary school system ("gymnasium") from grades 7 to 10 (most of them grade 9) and, therefore, above-average intelligent (and, thus, the main target group for science competitions). The German secondary school system consists usually (depending on the state) of two to three parallel tracks in which students are separated after their

Table 1 Participants in the study

Participants	IJSO	JtfO	Control	Total
Female, *n* (%)	72 (54)	52 (38)	164 (54)	288 (50)
Male, *n* (%)	61 (46)	85 (62)	140 (46)	286 (50)
Total	133	137	304	574
Mean age	13.9	14.4	15.2	14.7

primary schooling, ending after grade 4 (in some states, after grade 6). Depending on students' performance at the end of fourth grade, their teachers give a recommendation for one of the tracks. Parents are encouraged but not obliged to follow this recommendation. About one third of all students attend the gymnasium.

Instruments

Academic self-concept (school related) was assessed with 12 items of the standardized "Scales for the Assessment of School-Related Competence Beliefs" (SESSKO; Schöne, Dickhäuser, Spinath, & Steinsmeier-Pelster, 2002). Six items each were used to ask for social academic self-concept and individual academic self-concept. Internal consistencies were Cronbach's $\alpha = .92$ and Cronbach's $\alpha = .83$, respectively. The authors of the original scale validated their scales regarding factorial validity and criteria validity (high correlations to other self-concept scales and low correlations to other constructs, such as emotionality, worry, and hope for success (Dickhäuser, Schöne, Spinath, & Steinsmeier-Pelster, 2002). Students were asked to rate the accurateness of each statement for themselves. Likewise, a 4-point Likert scale was used ("I agree completely," "I rather agree," "I rather do not agree," "I do not agree at all"). Item examples can be found in Table 2.

To assess goal orientations, the standardized test SELLMO (translated title: Scales for the Assessment of Learning and Performance Goals) from Spinath, Steinsmeier-Pelster, Schöne, and Dickhäuser (2002) was used. It is based on Nicholls, Cobb, Wood, Yackel, and Patashnick's (1990) Motivational Orientation Scales and consists of 31 items. Eight items assess learning goals ($\alpha = .74$), performance approach goals ($\alpha = .82$), and work avoidance ($\alpha = .83$), respectively. Seven items assess performance avoidance goals ($\alpha = .71$). Learners had to answer all items on a 4-point Likert scale (I agree completely, I rather agree, I rather do not agree, I do not agree at all). All items began with the same prefix "In school, it is important for me …." Item examples can also be found in Table 2. The authors of the original scale (Spinath et al., 2002; see also Spinath & Steinmayr, 2012) reported expectable convergent and discriminated validities with related constructs (e.g. self-efficacy, achievement motivation).

Furthermore, the questionnaire consisted of items asking participants' age, gender, interest in school subjects (science and sports, respectively; 4-point Likert scale, from

Table 2 Item examples of assessed constructs

Construct	No. of items	Item example	Cronbach's α
Goal orientations		"In school, it is important for me …"	
Learning goals	8	"…to learn something interesting."	.74
Performance approach goals	8	"…to get better grades than others."	.82
Performance avoidance goals	7	"…that others think I'm smart."	.71
Work avoidance	8	"…not to work too hard."	.83
Academic self-concept			
Social self-concept	6	"I'm more intelligent than my classmates."	.92
Individual self-concept	6	"I'm better in school than I used to be."	.83

"not interested at all" to "very interested"), and last grades in all school subjects (GPA). As a precaution, all students were asked if they had previously participated in school competitions (and, if yes, in which ones).

Procedure

The different subsamples had to be recruited differently. For the participants of IJSO, the qualifiers for the second round were contacted by mail and asked for their participation (and their parents' agreement). If they agreed, they filled in our questionnaire and sent it back (together with another questionnaire which is not part of the current paper; cf. Dierks, Höffler, & Parchmann, 2014). For the first control group, two different secondary schools (one urban, one rural) were chosen and all students from ninth grade received the questionnaire during a regular lesson and filled it in subsequently. For the participants of JtfO, several secondary schools were contacted and asked for their general participation in the competition. If the school (and the students' parents) agreed, one of this paper's authors visited those schools and let the students who participated in JtfO fill in the questionnaire. In some cases, the questionnaires were sent via mail and teachers on site handled the procedure accordingly. No more than 15 min were required to fill in the questionnaire.

Results

As stated above, we compared participants of a science competition (*IJSO participants*) to non-participants who either did not participate in any competitions (non-participants) or participated in a sports competition (*JtfO participants*).

First, an expected difference between subgroups should be noted: Participants of IJSO had significantly better grades in all school subjects (GPA: $M = 1.72$, SD = 0.50) than JtfO participants ($M = 2.31$, SD = 0.54) who in turn had significantly better GPAs than non-participants ($M = 2.56$, SD = 0.60). (Please note that in the German school system, 1 is the best grade (*very good*) and 6 the worst (*failing*).) Contrast tests showed all differences to be significant at $p < .001$ with medium to large effect sizes (IJSO vs. JtfO: $d = 1.14$; IJSO vs. non-participants: $d = 1.47$; JtfO vs. non-participants: $d = .43$). While these differences are not unexpected, they have consequences regarding the interpretation of results. Therefore, additional calculations with GPA as a covariate will be reported.

Regarding interest in school subjects, expectably, IJSO participants ($M = 3.36$, SD = 0.64) were more interested in science than both other groups (JtfO participants: $M = 2.67$, SD = 0.87; non-participants: $M = 2.67$, SD = 0.71), $p < .001$; $d = .91$ and 1.00, respectively). On the other hand, also expectably, JtfO participants ($M = 3.89$, SD = .40) were more interested in sports as a school subject than both other groups (IJSO participants: $M = 3.10$, SD = 1.00; non-participants: $M = 3.45$, SD = .80), $p < .001$; $d = 1.03$ and .63, respectively). Non-participants were also more interested in sports as a school subject than IJSO participants ($p < .001$, $d = .40$).

Self-concept

In order to assess whether there are group differences between participants of the two investigated competitions and non-participants as well as gender differences, two-way independent analyses of variance were calculated. It was expected to find participants' self-concepts to be higher than non-participants'. Furthermore, boys were expected to exceed girls on their self-concept, but only in the non-participants group.

Concerning *social self-concept*, the ANOVA showed significant main effects for group (i.e. IJSO vs. JtfO vs. non-participants; $F(2,541) = 12.45$, $p < .001$, part. $\eta^2 = 0.044$) as well as for gender ($F(1,541) = 15.86$, $p < .001$, part. $\eta^2 = .028$). The interaction effect was not significant ($F < 1$). Boys had higher self-concepts throughout all groups. More detailed results as well as descriptive statistics can also be found in the Electronic Supplementary Materials (ESM).

Planned contrasts (Table 3) showed that IJSO participants had higher social self-concepts than either JtfO participants ($p < .001$, $d = .44$) or non-participants ($p < .001$, $d = .50$), while JtfO participants and non-participants did not differ significantly ($p = .81$). However, if GPA was added as a covariate, its large significant influence led to the disappearance of the group effect ($F(2,533) = 1.50$, $p = .225$) but not the gender effect, which even became larger ($F(1,533) = 123.27$, $p < .001$, part. $\eta^2 = .188$, see also ESM).

As to *individual self-concept*, only a small but significant main effect for gender was found ($F(1,548) = 4.51$, $p < .05$, part. $\eta^2 = .008$), which was mainly due to the differences in both the IJSO group and the non-participants group. Neither the interaction effect ($F < 1$) nor the main effect for group ($F(1,548) = 1.13$, $p = .322$) proved to be

Table 3 Effect sizes (Cohen's *d*) for pairwise comparisons between the three test groups regarding self-concepts

Variable	Group	Adjusted/unadjusted for GPA	IJSO	JtfO	Non-participants
Social self-concept	IJSO	Unadjusted	–	0.44***	0.50***
		Adjusted	–	n.s.	n.s.
	JtfO	Unadjusted	−0.44***	–	n.s.
		Adjusted	n.s.	–	n.s.
	Non-participants	Unadjusted	−0.50***	n.s.	–
		Adjusted	n.s.	n.s.	–
Individual self-concept	IJSO	Unadjusted	–	n.s.	n.s.
		Adjusted	–	−0.31*	−0.30**
	JtfO	Unadjusted	n.s.	–	n.s.
		Adjusted	0.31*	–	n.s.
	Non-participants	Unadjusted	n.s.	n.s.	–
		Adjusted	0.30**	n.s.	–

Depicted are GPA-adjusted values as well as unadjusted values

n.s. not significant

***$p < .001$; **$p < .01$; *$p < .05$

significant (see ESM). No contrast tests regarding group differences were thus statistically significant. Descriptive statistics can be found in the ESM. However, when GPA was added as a covariate, the group effect was significant as well ($F(1,540)=3.71$, $p<.05$, part. $\eta^2=.014$; see ESM). This was due to the significantly lower values for the participants of the science competition.

Goal Orientations

Regarding goal orientations, we expected participants from both competitions to have less performance avoidance goals and lower work avoidance than non-participants. JtfO participants were additionally expected to have more performance approach goals but less learning goals than IJSO participants. As to gender differences, we hypothesized that girls would have more learning goals than boys and would show less work avoidance.

Starting with learning goals, a two-way-ANOVA showed a significant main effect for group ($F(2,558)=17.48$, $p<.001$, part. $\eta^2=.059$; see ESM); that is, participants of IJSO had a significantly higher mean value than either JtfO participants or non-participants, which was confirmed by planned contrasts (Table 4). The difference to JtfO participants disappeared, however, when GPA was added as a covariate (Table 4). Participants of JtfO and non-participants did not differ. The expected main effect for gender was not confirmed ($F(1,558)=1.52$, $p=.218$; see ESM): Boys and girls did not differ in their learning goals. However, the difference between girls and boys was significant if the non-participant group was regarded separately ($t(295)=2.21$, $p<.05$, $d=.26$); that is, gender differences could be found only among non-participants. The interaction effect missed the significance level (see ESM).

As for performance approach goals, no significant differences were found at all; the interaction effect and the main effect for gender missed the significance level considerably ($F<1$), as did the main effect for group ($F(2,558)=2.11$, $p=.12$). The same was true when controlling for GPA (all $F<1$, except for group main effect: $F(2,550)=2.56$, $p=.08$). Descriptive values are to be found in the ESM.

Regarding performance avoidance goals (descriptive values; see also ESM), the two-way ANOVA yielded a significant main effect for group ($F(2,558)=9.18$, $p<.001$, part. $\eta^2=.032$; ESM); post hoc contrasts (Table 4) showed the non-participants' group to be superior to IJSO participants in that regard ($p<.001$, $d=.42$), but not to JtfO participants ($p=.06$). While the further effect remained significant ($p_{\text{one-tailed}}=.047$, $d=.18$) when using adjusted means due to the controlling of GPA as a covariate (Table 4), the main effect for group did not ($F(2,550)=2.19$, $p=.113$, part. $\eta^2=.008$). Effects for gender and the interaction were not statistically significant with or without the additional covariate (see ESM).

Lastly, significant differences in work avoidance could be found (descriptive values in ESM): As expected, boys had significantly higher values on the work avoidance scale than girls ($F(1,558)=15.93$, $p<.001$, part. $\eta^2=.028$; see ESM). Likewise, a significant main effect for group ($F(2,558)=6.99$, $p<.001$, part. $\eta^2=.064$) indicated work avoidance to be higher for non-participants (contrast test: $p<.001$, $d=.62$) as well as for JtfO participants ($p<.001$, $d=.52$) than

Table 4 Effect sizes (Cohen's *d*) for pairwise comparisons between the three test groups regarding goal orientations (GPA-adjusted values as well as unadjusted values)

Variable	Group	Adjusted for GPA	IJSO	JtfO	Non-participants
Learning goals	IJSO	Unadjusted	–	0.47***	0.59***
		Adjusted	–	n.s.	0.23*
	JtfO	Unadjusted	−0.47***	–	n.s.
		Adjusted	n.s.	–	n.s.
	Non-participants	Unadjusted	−0.59***	n.s.	–
		Adjusted	−0.23*	n.s.	–
Performance approach goals	IJSO	Unadjusted	–	n.s.	n.s.
		Adjusted	–	n.s.	n.s.
	JtfO	Unadjusted	n.s.	–	n.s.
		Adjusted	n.s.	–	n.s.
	Non-participants	Unadjusted	n.s.	n.s.	–
		Adjusted	n.s.	n.s.	–
Performance avoidance goals	IJSO	Unadjusted	–	n.s.	−0.42***
		Adjusted	–	n.s.	-0.18^{+}
	JtfO	Unadjusted	n.s.	–	n.s.
		Adjusted	n.s.	–	n.s.
	Non-participants	Unadjusted	0.42***	n.s.	–
		Adjusted	0.18^{+}	n.s.	–
Work avoidance	IJSO	Unadjusted	–	−0.52***	−0.62***
		Adjusted	–	−0.31*	−0.39***
	JtfO	Unadjusted	0.52***	–	n.s.
		Adjusted	0.31*	–	n.s.
	Non-participants	Unadjusted	0.62***	n.s.	–
		Adjusted	0.39***	n.s.	–

n.s. not significant

***$p < .001$; *$p < .05$; $^{+}p < .10$

IJSO participants (Table 4). Non-participants and JtfO participants did not differ on work avoidance ($p = .78$). While the interaction effect was not significant ($F(2,558) = 1.55$, $p = .21$), the descriptive values suggest the gender gap to be non-existent for IJSO participants. When GPA was controlled for, the effects became smaller but remained significant (see ESM).

Relations Between the Measured Variables

Regarding the relations between all measured variables and the participation in either a sports competition (JtfO) or a science competition (IJSO), we predicted several positive and negative correlations (Fig. 1, see above). For validation purposes, Fig. 2 shows the actual correlations. Non-significant correlations are not shown.

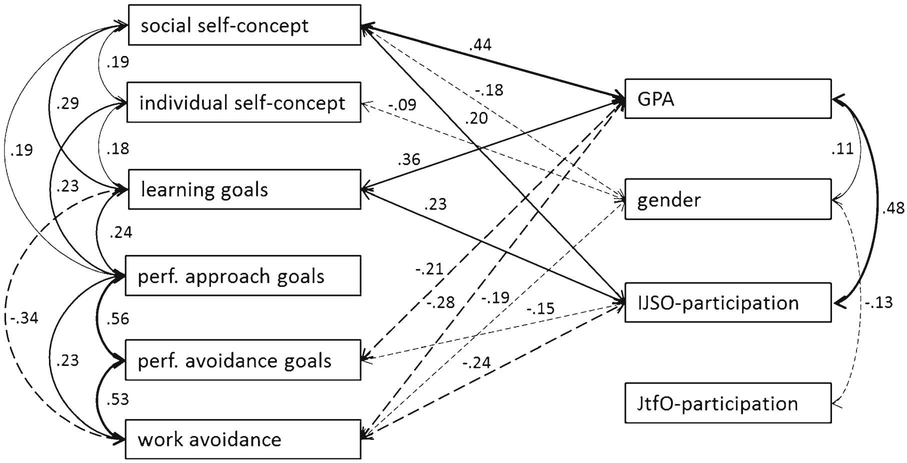

Fig. 2 Actual relations between all measured variables and the participation in either the JtfO or the IJSO. Participation in either competition (0 = no; 1 = yes) as well as gender (0 = male; 1 = female) were handled as categorical variables. For this analysis, GPA in terms of last grades in all school subjects was recoded so that larger values equal better performance. *Dashed lines* represent negative correlations; *continuous lines* represent positive correlations

Discussion

The current study aimed to compare academic self-concepts and goal orientations of participants in a science competition with non-participants of the same age group, represented by normal school classes and participants of a non-cognitive sports competition. The second competition was added to investigate whether effects might occur for participating in a competition in general or only with regard to the more cognitive science competition.

Taken together, our findings show considerable differences (and also similarities, some of them were not expected) between participants of a cognitive science competition, participants of a non-cognitive sports competition, and non-participants.

Regarding academic self-concept, no evidence for a BFLP effect was found. Instead, as expected, IJSO participants proved to be superior concerning their social self-concept to both non-participants and JtfO participants while there was no difference between the latter groups. That is, IJSO participants regarded themselves significantly better in terms of school performance than their classmates. As evident by their respective GPA's, this is also true; the effect disappears when GPA is added as a covariate. Therefore, we assume that better GPA's both lead to higher social self-concepts and increase the possibility for a participation in a science competition. While positive effects of enrichment measures and competitions on self-concept have also been documented (e.g. Olszewski-Kubilius, 1997), the results of this cross-sectional study cannot support such claims. To analyze developmental effects, a pre-post follow-up study is needed.

For individual self-concept, GPA's influence as a covariate is even stronger. When GPA was controlled for, participants in the science competition had lower individual self-concepts than participants in the sports competition as well as non-participants. As individual self-concept is about convictions regarding the improvement of one's abilities in previous years in school, this result might indicate that IJSO's high requirements lead participants to realize the comparatively low standards in school. Perhaps, they thus do not regard their improvements in school as significant. A more optimistic explanation might assume that this result mirrors exactly the self-critical attitude we would like to develop in scientists. However, this result is rather unexpected and warrants further examination.

As to gender differences, generally higher self-concepts of boys were expected as well as found; after controlling for GPA, the difference even became larger. That is, girls with comparable school achievements as boys have significantly lower self-concepts than boys—seemingly without objective reason. Moreover, it would have been plausible to expect no differences in the IJSO group, as those girls should have experienced that they are the boys' equals in terms of academic success. However, the results show that even successful girls in the science competition group still underestimated their abilities and still showed a significantly lower self-concept than comparable boys. The participation in the competition's first two rounds was therefore not able to positively influence the girls' self-concept in a significant amount. Even though they had been as successful as the boys in getting to the second round, their self-perception was still lower. These results ask for intervention studies specifically focusing on fostering girls' self-concept to keep them inside science enrichment programs and competitions and to support their career choices. Even more effective in this regard, perhaps, might be separate courses or even schools for girls and boys.

Regarding differences in goal orientations, participants of both competitions were expected to have less performance avoidance goals and to show lower work avoidance than non-participants. Additionally, participants of IJSO were expected to exceed both other groups on learning goals, as mastery in science generally requires intrinsic motivation, while JtfO participants should show more performance approach goals, as showing performance is an integral part of all sport disciplines and competitions.

Again, only some of these hypotheses were supported by the data. As to learning goals, the IJSO group indeed outperformed non-participants. Apparently, participants of this science competition are more willing to acquire new skills and knowledge (cf. Grant & Dweck, 2003) and are more intrinsically motivated (cf. Meece et al., 1988). While it is most likely that the IJSO participants acquired those learning goals beforehand and thus chose to participate, it is also possible that the competition itself enhanced their learning goals even further. After all, the effect was also detectable after controlling for GPA; that is, participants are more likely to have high learning goals even when the significant correlation to grades is accounted for. Longitudinal studies need to investigate this over time.

Interestingly, no general gender differences were identified, even though girls are typically more likely to have learning goals than boys (e.g. Freudenthaler et al., 2008; Patrick et al., 1999), as was also found among non-participants. Perhaps, this effect was negated due to the high selectivity in the IJSO group.

Regarding performance approach goals, no significant differences were found. Even though an especially strong focus on attaining success and demonstrating ability would have been plausible to expect in sports competition participants, no such difference could be found. However, it should be noted that we assessed goal orientations in this study in the sense of overall (school-related) personality traits. It might be the case that if the items focused more specifically on specific situations (like sports competitions), the expected difference would have been found. Indeed, some items which we assessed experimentally in the subsample of JtfO participants (but did not report separately and which were the same as the general items on goal orientations but with the prefix "in sports", instead of "in school") showed significantly higher performance approach goals. In any case, performance approach goals as a general trait did not differ between participants of different competitions and non-participants and thus do not seem to play a significant role for students' decisions whether to participate in competitions.

For performance avoidance goals, on the other hand, results were (partly) as expected: Non-participants deemed it more important not to demonstrate incompetence than IJSO participants. Against expectations, however, the difference between JtfO participants and non-participants was not significant. These results mirror our presumption that, as competitions have the inherent premise to try to exceed others in a public setting, performance avoidance should not be a typical goal orientation of participants. Additionally, of course, the better GPA's of IJSO participants make them even less likely to show performance avoidance goals, as they are generally better in school and thus do not feel the need to *prove their abilities*. This relation is also evident by the negative correlation between better grades and performance avoidance goals.

Lastly, work avoidance was expected to be more prominent in non-participants as well as in boys in general. Both hypotheses could be verified. IJSO participants were significantly less inclined to show work avoidance than both non-participants (expected) and JtfO participants (not expected). Girls were less work avoidant than boys in general, which has already been shown in other studies (e.g. Freudenthaler et al., 2008; Patrick et al., 1999). This difference is considerably smaller in the IJSO group, though. To be sure, it is not entirely clear if low work avoidance is a requirement for a participation in a science competition or if the additional work load in a competition combined with positive intrinsic and extrinsic outcomes also influences this goal orientation, specifically in boys.

Regarding the comparison between expected and actual relations (in terms of correlations) between the measured variables and the participation in one of the competitions, a large number of our expectations (but not all of them) were fulfilled. As expected, social self-concept was quite strongly correlated with GPA. Also, boys as well as IJSO participants tended to have higher self-concepts than girls or non-participants. We found also the expected relations between learning goals and IJSO participation, self-concept, and GPA, respectively, but not with gender. Students with higher GPAs and IJSO participants tended not to show, as expected, high work avoidance or performance avoidance goals. However, JtfO participants as well as boys did not show more performance approach goals than others, as no significant correlations were found. As stated above, this result might be partly explained by our assessment of goal orientations in the sense of overall (school-related) personality traits and not regarding specific situations like sports competitions. Furthermore, strongly positive correlations between performance goals and work avoidance as well as a negative correlation between work avoidance and learning goals were expected and found. The same is true for a positive relation between IJSO participation and GPA. Positive correlations between performance approach goals and self-concept, on the other hand, were not strictly expected but might mirror strong self-concepts and self-confidence of those who strive to get better grades than others.

All in all, these results can be regarded as an additional validation of our instruments, as most of our expected relations could be confirmed. Thus, our instruments indeed seem to measure the intended constructs.

Conclusions and Outlook

Regarding the design of enrichment activities and competitions and their implementation into school programs, for example, our study points out certain criteria to consider (even though our results' generalizability is yet to be proven). Against the assumption that competitions mainly foster performance goals (cf. Tauer & Harackiewicz, 1999), we did not find such a relation between participation in competitions and performance approach goals but rather with learning goals. The IJSO group was more learning goal oriented, had less performance avoidance goals, and showed less work avoidance than non-participants. Participants in the IJSO, different from the non-cognitive sports competition, seem to be driven by their interest in learning and the comparison with other interested and talented students in the area. It could be assumed that the competition might therefore act as a tool to foster learning processes by offering a benchmark to other students being better or more interested than their classmates. The cognitive aspect of the science competition, rather than the overall influence of a competitive situation, seems to be responsible for this effect. Moreover, the finding might also indicate a general high intrinsic motivation of participants and that intrinsic learning goals are more important reasons for participation than, for example, the expectation of prizes (cf. Czerniak & Lumpe, 1996).

Additionally, no gender differences on goal orientations were found within the group of IJSO participants. Hence, cognitively challenging competitions seem to foster learning goal orientations for boys and girls comparably, different from school environments where boys seem to show less high foci on learning goals.

It is also positive to state that we did not find an indication of a big-fish-little-pond effect; seemingly, IJSO participants' self-concepts did not suffer but rather profited from the competition.

However, even though the girls of the IJSO subsample accomplished the same tasks as the boys, their academic self-concepts were still significantly lower. The gender gap in self-concept has obviously not been solved by simply participating in a competition and experiencing equal success. This might have negative consequences on their achievements both in the competition and in school and is probably an important contributing factor of girls' general underrepresentation in science competitions (Lengfelder & Heller, 2002). Obviously, teachers and science competition managers should aim to support girls' self-concepts (even successful one's) even further, which might be one step to foster competitions as a successful method of raising and maintaining interest in STEM fields for more talented young students. Thus, our results give, as intended, some implications on how to implement and improve science competitions and enrichment opportunities.

Further quantitative and qualitative investigations of girls' self-concept with regard to participating in science competitions as well as means to strengthen their self-concepts might be in order. Additionally, longitudinal studies could provide insights into the development of both self-concept facets and goal orientations by comparing students at the beginning and during a competition with those who are equally successful at school but not participating. Such a study is planned at our institute for all Science Olympiads. The comparison with a non-cognitive competition provided insights into the specific effect of the science competition. Here, further comparisons would be promising for cognitive and creative, explorative science competitions, like science fairs and the Science Olympiads. In such studies, however, an expansion of instruments should be considered, for example regarding subject-specific self-concepts (cf. Köller et al., 2000) or other possible moderator variables such as interest or self-regulation. The lack thereof depicts one of the limitations of the present study but could not be adjusted due to time constraints and the inclusion of other variables which were not the focus of this paper. Moreover, for a better characterization of sports competition participants (which was not the main goal here), finer-grained instruments might be needed. The experimental investigation of sports-oriented goal orientations showed promising results in this study which differed considerably from general school-oriented goal orientations. Lastly, a replication with students with a more diverse background, different age groups, and even in different countries would allow for a better generalizability of the current results. At the moment, we only got a first impression on possible relations of different school competitions and motivation/self-concepts.

In sum, this study strengthens the ground for further empirical studies as well as for the research-based design of enrichment measures and competitions. Science competitions seem to be a promising tool to foster learning goal orientations for boys and girls and to be motivating enrichment activities for those students being interested in learning science. Longitudinal studies as well as intervention studies would be necessary to investigate if this aspect could be regarded rather as a starting condition or an outcome of a science competition.

The unsatisfying result regarding successful girls' low self-concepts asks for special scaffolding structures and more encouraging positive feedback especially for girls. Again, intervention studies should give better insights into how this crucial gap might be overcome in the future to encourage more girls to choose a career in science as well.

Acknowledgments We would like to thank Dr. Heide Peters, Wilfried Wentorf, and Dr. Pay-Ove Dierks for their support with data collection as well as Dr. Johannes Wohlers for his professional input. The current research was part of a project supported by the German Research Foundation (Grant no. HO 4303/5-1).

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