International Journal of Educational Research 50 (2011) 241–250

Contents lists available at SciVerse ScienceDirect

International Journal of Educational Research

journal homepage: www.elsevier.com/locate/ijedures

Positive biases in self-assessment of mathematics competence, achievement goals, and mathematics performance

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ARTICLE INFO

Keywords:
Achievement goals
Competence
Perceptions
Self-assessment
Bias
Mathematics

ABSTRACT

The study examined how biases in self-evaluations of math competence relate to achievement goals and progress in math achievement. It was expected that performance goals would be related to overestimation and mastery goals to accurate self-assessments. A sample of French high-school students completed a questionnaire measuring their math achievement goals and their perceived competence in math. Students' math grades for the three trimesters of the school year were collected from school records. Bias in self-evaluations was computed by comparing students' rating on the 'perceived competence in math' scale with their actual math achievement as measured by their second trimester math grades. Students were classified into one of three groups (over-raters, accurate raters, or under-raters) depending on whether their self-perceptions of competence in math were higher than, similar to, or lower than their relative math achievement in their class. As expected, overrating of one's performance was related to performance goals. Furthermore, the over-raters were the only group who progressed in their math achievement from Trimester 2 to 3. No relation was found between mastery goals and accurate self-assessment.
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1. Biased self-assessments of competence

Biased judgments about self have received considerable theoretical and empirical attention, especially from research on metacognition and more recently from research on motivation and self-regulated learning (e.g., Stone, 2000).

In the field of metacognitive research, metacognitive judgments refer to the "awareness of one's own knowledge and ability to understand, control and manipulate individual cognitive processes" (Osman & Hannafin, 1992, p. 83). From this perspective, research investigating the calibration of metacognitive judgments focuses on the relationship between self-assessment of knowledge or understanding and actual performance or understanding (Glenberg & Epstein, 1985; Glenberg, Wilkinson, & Epstein, 1982; Lin, Moore, & Zabrucky, 2001; Stone, 2000). A commonly used paradigm consists of instructing students to first read a series of text passages and then to ask them to rate their understanding or to predict their performance on a comprehension test. Using this paradigm, researchers found that individuals are not always well calibrated, but sometimes underestimate or more frequently overestimate their comprehension. Glenberg et al. (1982) called this overestimation "illusion of knowing".

In the field of achievement motivation and self-regulated learning a great deal of research has been devoted to self-related perceptions using concepts such as self-esteem, self-concept, self-confidence, perceived competence, or self-efficacy (for reviews see Bong & Clark, 1999; Pajares, 1997; Schunk & Pajares, 2005). A feature that these academic self-perception

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doi:10.1016/j.ijer.2011.08.005

components have in common is that they all focus on the way individuals perceive or evaluate their own competence or ability to achieve a given task. Thus, compared to metacognitive judgments, academic self-appraisals are not only focused on the evaluation of one's knowledge state but also include "the emotional and motivational significance of an individual's appraisals and expectations of his or her adaptive abilities" (Masterpasqua, 1989 cited by Boekaerts, 1991, p. 2). Research consistently found that self-related perceptions of academic competence are associated with important educational behavior such as self-regulation, effort, persistence, and achievement (e.g., Martin & Debus, 1998; Pajares, 1996; Zimmerman, 2000).

Recently, researchers have also investigated the accuracy of these self-assessments and found that they are generally marked by a positive bias (positive illusion of competence; Robins & Beer, 2001). However, most studies also revealed that not all individuals overestimate their abilities; some individuals underestimate their competence (illusion of incompetence; Bouffard, Boisvert, & Vezeau, 2003) while others have realistic self-assessments (e.g., Robins & Beer, 2001). Given these individual differences in the accuracy of self-assessments, there has been a call for research to explore the factors affecting self-assessment accuracy. Boekaerts (1991) and Blatchford (1997a) suggested integrating motivational orientations such as achievement goals in the study of these potential predictors.

2. Achievement goals

Achievement goals are cognitive representations of purposes students are pursuing in an achievement task and they can be seen as "different ways of building and maintaining self-esteem" (Dweck, 1990, p. 208). Traditionally, two major classes of goals have been distinguished: mastery and performance goals. Mastery goals orient the individual to focus on the task and on progress by aiming to develop competence and mastery. Performance goals orient the individual to focus on the self and to demonstrate competence relative to others. Recent theories further distinguish approach and avoidance dimensions within performance goals (e.g., Elliot & Harackiewicz, 1996). Performance approach goals represent a focus on acquiring or maintaining a positive outcome or state (e.g., by gaining favorable judgments of one's competence or by outperforming others). Performance avoidance goals represent a focus on moving or staying away from a negative outcome or state (e.g., by avoiding unfavorable judgments of one's competence or avoiding failure) (Elliot, 1999; Elliot & Harackiewicz, 1996). Although the approach and avoidance distinction has also been applied to mastery goals and a fourth goal – master avoidance – has been posited (Elliot, 1999; Pintrich, 2000), there is currently little research that has examined that goal (Anderman, Urdan, & Roeser, 2005). In the present study, therefore, we will focus on the three goals defined above.

Studies investigating the relationship between achievement goals and learning activities generally found that mastery goals are associated with strategies promoting effective learning such as deep processing strategies (e.g., paraphrasing, relating, organizing) and self-regulatory activities, while performance goals are related to shallow-processing strategies (e.g., memorization or rote-learning) and less self-regulation (e.g., Ames & Archer, 1988; Bouffard, Boisvert, Vezeau, & Larouche, 1995; Dupeyrat, Escribe, & Mariné, 2006; Harackiewicz, Barron, Tauer, & Elliot, 2002).

3. Achievement goals and biased self-assessments of competence

In spite of the importance attached to achievement goals in educational research, there are very few studies investigating their effects on self-assessment biases. To the best of our knowledge, only one study examined the relationship between achievement goals and the accuracy of metacognitive judgments (illusion of knowing). Using a reading comprehension and error detection paradigm, Kroll and Ford (1992) found that students who were poor in error detection and who over-rated their comprehension of the text had significantly higher performance goal scores than realistic students. Mastery goals were not related to biases in self-ratings of comprehension but were positively related to error detection. In another study, parameters similar to performance and mastery goals were compared with a more general index of metacognitive self-assessment (Lin, Moore, & Zabrucky, 2004). Individuals who scored high on competitiveness, a tendency to seek to outperform others (as with performance approach goals), gave themselves higher metacognitive self-evaluations. However this study did not use any external criteria, such as test performance, to assess over- or under-estimation.

Other research investigated how achievement goals, or similar concepts, related to more global and motivational aspects of self-assessment. Robins and Beer (2001) conducted a laboratory and a field study in which a parameter similar to performance approach goals was included. In their laboratory study, participants were asked to rate the extent to which they themselves and their peers contributed to the effectiveness of a group decision-making task. Over- and under-estimation was computed by comparing self and peer evaluations. Participants also rated the extent to which they felt ego-involved by indicating how important it was to them to perform well in the task, a concern similar to that for performance approach goals. Over-rating one's effectiveness in the group task was found to be positively related to ego-involvement. In their field study, a sample of students was followed longitudinally through college over a 4-year period. Participants were recruited during the first week of their first year of college and then assessed annually throughout college. Self-perceived academic ability was measured only once in the first assessment by direct self-reports of ability relative to other students and expected performance in college. Self-evaluation bias was computed by comparing self-perceived ability with actual academic ability (SAT scores and high school GPAs). Ego-involvement (or performance approach goals) was measured by asking students to rate the importance of academic achievement (i.e., getting good grades and the importance of academic ability for the sense of self-worth). Those students who overestimated their academic ability were not found to be high on ego-involvement but

to the contrary showed a tendency to view grades as less important over time. However, it is notable that self-perceived ability was measured only once during the first assessment wave. Thus, it cannot be excluded that students who overrated their academic ability at the beginning of their studies became more realistic over time. Finally, another study compared accuracy of self-concept concerning mathematics to students' achievement goals in a sample of high school students (Martin & Debus, 1998). Students' over- and under-ratings of their competence was determined by matching their self-reports of mathematics competence with appraisals made about the student by his/her teacher. Over-rating of mathematics competence was positively associated with performance goals. However, one limitation of this study is that a more objective indicator of mathematics competence, such as mathematics performance, could have been used to determine accuracy of self-assessments instead of teacher ratings.

4. The purposes of the study

Taken together, it is difficult to draw firm conclusions from these few studies because of the differences in conceptualization and measurement of self-rated competence and achievement goals. Nevertheless, the results of all the studies reviewed here converge to show that over-estimation of one's competence or knowledge is related to a concern about the impression one is making on others and about one's performance relative to others; in other words with a concern with performance approach goals. The primary focus of the present study is thus to further explore the relations between achievement goals and biases in self-assessment of competence in one academic domain (mathematics). The present study proposes that performance approach goals are associated with positive biases in self-assessment of competence. This hypothesis is drawn from the results of the few related studies conducted on biases in metacognitive judgments and on self-assessment of competence. An exploratory aspect of this study pertains to how mastery and performance avoidance goals relate to accuracy of self-assessment. Based on findings from the self-regulated learning literature, it is conjectured that mastery goals are related to realistic self-assessments of competence. Given that mastery goal oriented students tend to focus on the mastery of the task itself, to use deep-processing strategies, and to operate in reference to their previous performance (Martin & Debus, 1998), we predict that they will strive for accurate information in order to evaluate their current level of mastery. We also believe that performance avoidance goals will be related to a tendency to overestimation. Because performance avoidance goal oriented students are mainly concerned with avoiding negative judgments about their abilities, we believe they will pretend to know or master slightly more than they really do in order to meet their goal. Thus, we expect performance avoidance goals to be related to positive biases in self-assessment of competence.

Competence self-assessments, as examined in this study, will involve judgments of one's own attainment relative to an external standard or in relation to other students. The main reason for this choice is that it can be used more readily to make comparisons with objective measurements of relative attainment such as grades (Blatchford, 1997b).

Another important question pertains to the consequences of biased self-assessments. This question has not yet received a clear-cut answer in the literature. Some theorists believe it is it is common behavior to distort reality in a positive direction and they advocate the proven beneficial consequences of positive self-appraisals (whether realistic or optimistic) on motivation and performance (e.g., Bandura, 1977, 1993; Taylor & Brown, 1988). For example, Taylor and Brown (1988) asserted that positive illusions are associated with "higher motivation, greater persistence, more effective performance and ultimately, greater success" (p. 199). For Bandura (1977, 1993), human accomplishments and positive well-being require an optimistic sense of personal efficacy. Others consider that the thesis relating positive illusions, well-being and performance still remains to be proven (e.g., Colvin & Block, 1994) and highlight the risks related to unrealistic self-views in either direction because overestimation may lead the person to become demoralized through repeated failure while underestimation can lead a person to avoid opportunities for skill development (Schunk, 1981). Empirical findings examining this issue have shown mixed evidence. Several studies found that over-rating one's competence is related to higher academic performance (e.g., Lopez, Little, Oettingen, & Baltes, 1998; Martin & Debus, 1998). However, Robins and Beer's (2001) longitudinal study revealed that over-estimators did not receive better grades nor were they more likely to graduate than accurate estimators or under-estimators. Therefore the questions about the beneficial effects of overestimation remain unanswered, and the present study will also explore this issue.

Finally, because the present study focuses on biases in self-assessment of mathematics competence and given that a number of studies established gender differences in competence and expectancy beliefs (for reviews see Barres, 2006; Dar-Nimrod & Heine, 2007; Halpern et al., 2007; Meece, Glienke, & Burg, 2006; Wigfield & Wagner, 2005), gender differences will also be examined in the present study. Because these studies found that girls generally have lower perceptions of competence in math compared to boys, we expect that girls will underestimate their mathematics competence more than boys will.

To summarize, the goal of the present study is twofold: The primary purpose was to examine the relationships between biases in self-assessment of competence and achievement goals. We hypothesize that both performance goals (approach and avoidance) will be related to overestimation of math competence because performance goals lead students to be concerned with impression management. Performance approach oriented students will therefore overestimate their competence in order to obtain a good impression from others, and performance avoidance oriented students will overestimate their performance in order to avoid obtaining a bad impression from others. Mastery goals are predicted to be related to accurate estimation of math competence, because mastery goals lead students to focus on progress and task mastery. Mastery goal oriented students will therefore tend to evaluate their current level of competence accurately.

A secondary purpose was to explore gender difference in competence self-assessment and the consequences of overestimation of one's competence on academic performance.

Given previous findings on gender differences in competence and expectancy beliefs in mathematics, we expect that girls will underestimate their mathematics competence more than boys.

Because previous studies examining the effects of overestimation of one's competence have led to mixed evidence, our study will further explore this issue.

5. Method

5.1. Participants

The participants were 461 8th and 9th grade high-school students from two schools in France (50% girls, aged 13–16 years). At the beginning of the school year, students had been assigned by school administrators to one of 20 classes, with 23–29 students per class. They took all their mathematics courses among the same group of peers throughout the entire school year.

5.2. Procedure

At the end of the second trimester, shortly before the students received their second trimester grade reports, participants were asked to complete a questionnaire measuring different attitudes and motivation towards mathematics and comprising scales assessing their achievement goals and their perceived competence in mathematics. We also obtained students' math grades for the three trimesters of the school year from school records.

5.3. Measures

Mathematics achievement goals measurements were adapted and translated from the *Patterns of Adaptive Learning Survey* (PALS; Midgley et al., 2000). The PALS is one of the most widely used survey methods for assessing achievement goals and gives highly reliable and valid measurements of students' personal mastery, performance approach and performance avoidance goals (Anderman et al., 2005; Midgley et al., 1998; Ross, Blackburn, & Forbes, 2005). Five items assessed a mastery goal orientation (e.g., "*Is it important for you to learn new things in mathematics?*"; $\alpha = .86$), 5 items assessed a performance-approach goal orientation (e.g., "*Is it important for you that the other students in your class believe you are good at mathematics?*"; $\alpha = .89$), and 4 items assessed a performance-avoidance goal orientation ("*Is it important for you to avoid looking like you are have trouble in mathematics during class work?*"; $\alpha = .73$). All ratings were made on 5-point scales (1 = *not important at all*, 3 = *moderately important*, 5 = *very important*).

Perceived competence in mathematics was measured with a single item: "*In your opinion, compared to other students from your class, in mathematics you are*: *much worse than the others* (1), *like the others* (3), *much better than the others* (5)". This single item has proved to be a relevant measure of one's perceived competence relative to the others in several studies (Blanton, Buunk, Gibbons, & Kuyper, 1999; Huguet, Dumas, Monteil, & Genestoux, 2001; Seaton et al., 2008).

Mathematics achievement. Students' mathematics grades for the three trimesters of the school year were obtained from school records. In the French grading system, grades are given on a 20-point scale, with 20 representing the highest grade, and all grades from 10 upwards representing a "pass". First trimester grades were used to control for previous mathematics achievement and third trimester grades were used to compute an indicator of progress by subtracting Trimester 2 grades from Trimester 3 grades. Because data were collected shortly before the students received their second trimester grade reports, second trimester grades were used to determine biases in self-assessment. Indeed students receive graded feed-back for each mathematics exam they take during the trimester and the trimester grade report is the average of the grades students receive for the exams taken during a trimester.

Progress in mathematics. Because Trimester 2 mathematics grades were used to determine biases in mathematics self-assessments and in order to avoid any confounding variables when analyzing students' progress in mathematics, an indicator of mathematics progress from Trimester 2 to Trimester 3 was computed by subtracting Trimester 2 grades from Trimester 3 grades. Positive values indicate progress and negative values indicate regress

6. Results

6.1. Determining biases in self-assessment of perceived competence in math

Consistent with Assor, Tzelgov, Thein, Ilardi, and Connell's (1990) proposed methodology, biases in self-assessment were computed by comparing students' rating on the 'perceived competence in math' scale with their actual math achievement as measured by their second trimester math grades. Because perceived competence and achievement were measured on different metrics, we first transformed them to a comparable metric. To do so we created three groups of perceived competence based on students' responses to the 'perceived competence in math' item. Students who scored 1 or 2 (corresponding to a self-assessment of being much worse or worse than the others) were considered to be low in perceived competence, those who scored 3 (corresponding to a self-assessment of being like the others) were considered to have an

average perceived competence, and those who scored 4 or 5 (corresponding to a self-assessment of being better or much better than the others) were considered to be high in perceived competence.[1] A tripartite split was also performed on students' Trimester 2 math grades. In the French school system, each time students receive graded feed-back on their performance, their own grade is accompanied by their class average grade. Therefore, each student is well aware, not only of their class average grade but also of their own standing relative to their class average grade. Because perceived competence in math required students to compare their math competence to the other students of their class, this was done separately for each of the 20 classes. Students whose grades were within a range of 1 grade of their respective class's average math grade were classified as average achievers, those whose grades were more than 2 grades below their class's mean math grade were classified as low achievers, and those whose grades were more than 2 grades above their class's mean math grade were classified as high achievers.[2] All students whose grades fell between two competence groups were excluded from this classification. For example, if the average class grade in mathematics was 11, students of this class were classified as average achievers if their grades were within a range between 10 and 12 (inclusive); students were classified as low achievers if their grades were 9.0 or below; students were classified as high achievers if their grades were 13.0 or above. All students of this class whose grades were between 8.1 and 9.9 and between 12.0 and 12.9 were excluded because they could not be unambiguously classified respectively as low or average achievers, or as average or high achievers. This procedure led us to exclude approximately 15% of the participants from further analysis in the present study.

The three 'perceived competence in math' groups and the three mathematics achievement groups were then compared. Students were classified into either over-raters, accurate raters, or under-raters depending on whether their self-perception of competence in math was higher than, similar to, or lower than their relative math achievement in their class. Students were classified as accurate raters in the following cases: students who were in the average perceived competence group and in the average achievers group, students who were in the low perceived competence group and in the low achievers group, and students who were in the high perceived competence group and in the high achievers group. Students who were in the low perceived competence group and who were either in the average or high achievers group were classified as under-raters, and those who were in the high perceived competence group and who were either in the average or low achievers group were classified as over-raters.

Means and standard deviations for students' perceived competence, achievement goals and math grades according to their self-assessment group are given in Table 1.

6.2. Preliminary analyses: Trimester 1 math achievement and gender effects

In order to control that the accurate raters, under-raters, and over-raters groups differed in terms of their previous math achievement, a one way ANOVA was performed on students' Trimester 1 grades. Results revealed no significant differences between the three self-assessment groups (see Table 1).

Possible gender differences on bias in self-assessment were tested using a chi-square test. The result of this test was significant ($\chi^2(2) = 16.37$, $p < .001$): there were approximately as many female as male students in the accurate raters group (140 girls vs. 141 boys), more female than male students in the under-raters group (38 girls vs. 16 boys), and fewer female than male students in the over-raters group (17 girls vs. 37 boys).

Possible gender effects on the other variables were examined using a one way multivariate analysis of variance (MANOVA). Results revealed significant multivariate effects ($F(7, 376) = 7.12$, $p < .001$; $\eta^2 = .117$; Wilks' Lambda: $\lambda = 0.88$). Univariate tests revealed significant gender differences for mastery goals ($F(1, 382) = 4.37$, $p = .04$, $\eta^2 = .011$), performance approach goals ($F(1, 382) = 31.02$, $p < .001$, $\eta^2 = .075$), performance avoidance goals ($F(1, 382) = 4.07$, $p = .04$, $\eta^2 = .011$), and for perceived competence in math ($F(1, 382) = 10.22$, $p = .002$, $\eta^2 = .026$). As displayed in Table 2, girls scored lower than boys on all these variables except on mastery goals where they scored higher than boys.

6.3. Bias in self-assessment, achievement goals and math achievement

Differences between the accurate raters, under-raters, and over-raters groups on achievement goals and on math progress were analyzed using a MANOVA. Because of the gender differences revealed in the preliminary analyses, an initial

[1] A set of analyses were conducted where students who rated 2 or 4 on perceived competence scale were excluded. The results replicated exactly those presented in the paper. Because excluding the students who rated 2 or 4 on perceived competence scale reduced the sample to nearly the half of the participants, we prefer presenting the results of the entire sample.

Furthermore, a number of studies demonstrated the existence of a central tendency error (e.g., Bardo, Yeager, & Klingsporn, 1982). This error consists in the fact that when a neutral response point is available in a Likert scale, respondents tend to choose it to the detriment of more extreme points. Accordingly, we may presume that the respondents who chose 2 were probably closer to 1 than to the neutral point 3; similarly, it is likely that the respondents who chose for 4 were closer to 5 than to 3.

[2] In the French grading system, grades from 10 upwards receive a different verbal descriptor every 2 grade points. The typical verbal descriptors are *passable* from 10 to 12, *satisfactory* from 12 to 14, *highly satisfactory* from 14 to 16, *very good* from 16 to 18, and *excellent* from 18 to 20. For this reason it can be considered that 2 grade points have a psychological meaning for the students and was retained as the criteria to classify them into low or high math achievement groups. In order to ensure that the three math achievement groups truly differed from each other, a more restrictive criterion was used to create the average achievement group, considering that only students whose math grades differed by 1 grade point from their class mean grade could be classified into this group.

Table 1
Means and standard deviations for students' perceived competence, achievement goals and math grades according to their self-assessment group.

	Under-raters ($N = 54$)		Accurate raters ($N = 282$)		Over-raters ($N = 54$)	
	M	SD	*M*	SD	*M*	SD
Perceived competence in math	2.50	.54	3.05	1.18	3.46	.61
Mastery goal	3.82	.68	3.94	.78	3.88	.83
Performance approach goals	1.45_{b}	.54	1.86_{ab}	.86	2.10_{a}	1.08
Performance avoidance goals	2.06	.73	2.22	.88	2.39	1.03
Math grade Trimester 1	12.92	3.20	12.25	4.54	11.03	3.65
Math grade Trimester 2	12.83	3.15	11.53	4.96	8.94	2.80
Math grade Trimester 3	12.75	3.29	11.75	4.66	9.81	3.18
Progress (Trimester 2–Trimester 3)	$-.08_{b}$	1.66	$.22_{ab}$	1.77	$.83_{a}$	1.69

Note: Lettered subscripts denote a significant difference. Group means sharing the same subscript are not significantly different at the $p < .05$ level.

Table 2
Means and standard deviations for female and male students' perceived competence, achievement goals and math grades.

	Female		Male	
	M	SD	*M*	SD
Perceived competence in math	2.87	1.08	3.21	1.04
Mastery goal	3.84	.76	3.00	.78
Performance approach goals	1.59	.67	2.08	1.00
Performance avoidance goals	2.14	.85	2.32	.92
Math grade Trimester 1	11.95	4.50	12.44	4.03
Math grade Trimester 2	11.44	4.72	11.29	4.52
Math grade Trimester 3	11.62	4.45	11.66	4.31
Progress (Trimester 2–Trimester 3)	.18	1.77	.35	1.75

MANOVA included gender in order to test the interaction between gender and bias in self-assessment. This interaction was not significant and was therefore excluded. A follow-up MANOVA revealed significant multivariate effects ($F(8, 762) = 3.33$, $p < .001$; $\eta^2 = .034$; Wilks' Lambda: $\lambda = 0.93$). Univariate tests revealed significant differences for performance approach goals ($F(1, 384) = 7.50$, $p < .001$, $\eta^2 = .038$) and for progress from Trimester 2 to Trimester 3 ($F(1, 384) = 12.908$, $p < .001$, $\eta^2 = .022$).

Scheffés post hoc tests ($p < .05$) showed that the over-raters group scored higher on performance approach goals and progressed more from Trimester 2 to Trimester 3 than the under-raters group (Table 1). The over-raters and accurate raters groups did not significantly differ from each other. The under-raters group had significantly higher performance approach goals than the accurate group but did not differ significantly from the accurate group in terms of progress from Trimester 2 to Trimester 3.

7. Discussion

The purpose of this study was to investigate the existence of relationships between achievement goals and biases in self-assessments of competence. It also examined gender differences in self-assessments and the effect of overestimation on performance progress.

7.1. Biases in self-assessments of competence

In the present study, biases in self-assessments of competence were computed in reference to Assor et al.'s (1990) methodology which consists in comparing students' rating on the 'perceived competence in math' scale with their actual math grades. In order to ensure the validity of this methodology, we run complementary analyses only with students who responded on the most extreme response points of the perceived competence math' scale. Results from these analyses strictly replicated those reported in the present study.

Consistent with a wealth of previous findings (e.g., Martin & Debus, 1998; Robins & Beer, 2001; Taylor & Brown, 1988), results from the present study showed that not all students accurately assessed their competence. Some students, especially boys, overestimated their competence, while others, especially girls, underestimated their competence.

This gender difference can be explained in terms of gender stereotypes and gender-role socialization. In a series of studies, Beyer (1990, 1998, 1999, 2002) found that women underestimated their performance on masculine gender-typed tasks (e.g., sports, mathematics), but found no gender differences in the accuracy of self-assessments for feminine gender-typed tasks (e.g., quiz on stars and fashion, grammar and syntax) or neutral tasks (e.g., common knowledge in literature and geography). Beyer (1990, 1999) concluded that women are not inaccurately negative self-assessors in general and explained this pattern

of results by self-consistency. Women's low expectancies or self-perceptions for masculine gender-typed tasks negatively bias their performance self-assessment. This explanation is compatible with the findings of the present study. Girls' significantly lower perceived competence in math than boys' may have negatively affected their self-assessment of math performance, leading the girls to underestimate their relative math achievement compared to their classmates.

However, in the present study, while more girls than boys underestimated their math competence, the majority of girls made accurate self-appraisals and some overestimated their math competence. Thus, gender *per se* or gender-role socialization cannot be the sole explanation of biases in self-assessment of math competence.

7.2. Biases in self-assessments of competence and achievement goals

Another explanation at the core of the present study involves achievement goal orientations. More specifically, we expected that overestimation of one's competence would be related to performance goals (whether approach or avoidance oriented) and that realistic or accurate self-assessments would be related to mastery goals. Results were only partially consistent with these hypotheses. In line with our expectations, students who overestimated their math competence had significantly higher performance approach goals than those who underestimated their math competence but did not significantly differ from those who were accurate. Furthermore, students' performance avoidance goals did not differ with regard to the accuracy of the self-assessment of their mathematics competence. The expected relationships between accurate self-assessments and mastery goals were not confirmed in the present study. This pattern of results leads us to the conclusion that the relationship between biases in self-assessment and achievement goals may not be as simple or as straightforward as we initially believed.

At least two alternative or complementary points can provide an explanation for the pattern of findings in the present study. One is based on metacognitive activities, the other on the specific motives and standards guiding the self-assessment process.

7.3. Biases in self-assessments of competence and metacognitive abilities

First, according to Dunning, Johnson, Ehrlinger, and Kruger (2003) and Kruger and Dunning (1999), overestimation occurs mainly in unskilled or incompetent subjects because incompetence not only causes poor performance but also the inability to accurately evaluate one's performance. In other words, incompetent people not only lack the necessary cognitive abilities to obtain good performance but also the metacognitive abilities to recognize their poor performance. This explanation is compatible with previous findings that performance goal oriented students (whether approach or avoidance oriented) do not actively engage in metacognitive activities such as planning, supervising, or controlling their activities (e.g., Bouffard, Bouchard, Goulet, Denoncourt, & Couture, 2005; Miller, Behrens, & Greene, 1993; Pintrich & Schrauben, 1992). It might thus be that because performance goal oriented students lack metacognitive abilities, they are unable to recognize their poor performance and generally tend towards overestimation. Some results of the present study, however, place limitations on this explanation. Indeed, in our sample, the students who overestimated their competence did not differ from those who accurately estimated or underestimated their competence in terms of their first trimester math grades. Furthermore, with an average math grade around 11 on a 20 point scale, the students who overestimated their competence can be considered to have been achieving about average in math during the first trimester and thus cannot reasonably be considered as incompetent in math. It is nevertheless intriguing that even though their average grades dropped nearly 2 grade points from the first to the second trimester, the students who overestimated their competence did not adjust their self-appraisals to that decline in their math achievement. These students apparently based their self-appraisals of competence on their Trimester 1 grades, but did not take into account the precipitous drop of their math grades for Trimester 2. A possible account for this result, compatible with findings from some studies (e.g., Bong & Skaalvik, 2003; Bouffard, Vezeau, Roy, & Lenglé, 2011), is that self-perceptions are relatively stable over time and resilient to variations in performance. Students might not have re-evaluated their overall perception of math competence in spite of a decline in their math performance. A possible reason is that these students consider that this decline is not representative of their actual math abilities.

However, the hypothesis that students who overestimated their competence simply lack the essential metacognitive abilities to recognize a decline in their achievement cannot be excluded here. Nevertheless, a more plausible account would be that students who overestimated their competence are not so much deficient in metacognitive skills as unwilling to engage in metacognitive activities. Thus, a possible explanation of the relation between overrating one's competence and performance goals could be that students who overestimate their competence because they are also inclined towards performance goals, are not willing to exert the necessary effort to accurately monitor their performance and/or changes in task demands.

If this explanation in terms of metacognitive activities can perhaps account for the observed relationship between illusion of competence and performance goals in the present study, it does not seem to apply to the observed relationship between bias in self-assessment and mastery goals. Indeed, previous research has shown that mastery goal oriented students actively engage in metacognitive activities (e.g., Bouffard et al., 2005; Miller et al., 1993; Pintrich & Schrauben, 1992). It could therefore be expected that the metacognitive activity of mastery goal oriented students leads them to monitor both their performance and their task demands accurately, thus resulting in accurate self-assessments. However, in the present study we found no evidence that students who accurately assessed their competence have higher mastery goal scores than those who under- or overestimate their competence.

7.4. Bias in self-assessment of competence and standards or motives of self-assessment

An alternative or complementary explanation can be provided in reference to the standards used by students in the self-assessment process as well as to the motives guiding these processes. In terms of the standards used to measure self-assessment of competence, the indicator used in the present study focused primarily on social comparison. Research on the standards or the nature of the information used in self-assessment has shown that there are at least three sources of information that can be used for self-assessment (Wayment & Taylor, 1995): normative or social comparison standards (the performance of others), absolute standards (the requirements of the task itself), and self-referenced standards (one's own past performance). Achievement goal theorists (e.g., Brophy, 2005; Elliot, 1999; Jagacinski & Duda, 2001; Pintrich, 2000) agree that students who adopt performance goals tend to use primarily social comparison standards to judge their level of competence. Some authors also contend that students who adopt mastery goals do not use social comparative standards, but rather rely on absolute or self-referenced standards. Even though there is some evidence that mastery goal oriented students also use social comparative standards (e.g., Butler, 1989, 1993, 1995; Régner, Escribe, & Dupeyrat, 2007), social comparison may not be the unique or primary source of information mastery goal oriented students use in their self-assessment process. Thus future research may extend the present study by incorporating different criteria for measuring competence self-assessments, tapping into the different information sources used in self-assessment. This may not only advance the understanding of how biases in self-assessment relate to achievement goals but also how this relationship is affected by the type of information students use in their self-assessment process.

Research on self-assessment processes has also proposed the existence of different motives guiding self-assessment (e.g. Baumeister, Tice, & Hutton, 1989; Butler, 1995; Elliot & Mapes, 2005; Heath & Glen, 2005; Sedikides, 1993; Sedikides & Skowronski, 2000; Wayment & Taylor, 1995). People can be motivated to maintain or enhance their self-views or self-esteem (self-enhancement and self-protective motives), to develop or improve themselves (self-improvement motive) or to have an accurate sense of their own abilities (accuracy or self-assessment motive). These different motives can be conceptualized in terms of achievement goals or articulated with achievement goals, and account for biases in self-assessment (see Butler, 1995, 2005; Gramzow, Elliot, Asher, & McGregor, 2003). For performance goal oriented individuals, focused on the demonstration of competence and the maintenance of self-worth, self-assessments may primarily serve an emotional or ego-defensive function and therefore be guided by self-enhancement and/or self-protection motives leading to biased positive self-assessments. These self-enhancement or self-protective motives associated with performance goals could lead to overestimations through two mechanisms: by orienting students' attentional or metacognitive resources towards positive rather than negative aspects of their achievement (e.g., Ehrlinger, 2008) and/or by prompting responses favorable to self-presentation when completing the surveys assessing perceived competence (e.g. Lin et al., 2001; Martin & Debus, 1998).

For mastery goal oriented individuals, whose primary concern is acquiring knowledge and skills, the main motive guiding self-assessment processes may be to obtain useful information for assessing their current competence level accurately, in order to regulate further learning efficiently. In other words, for a mastery goal oriented person, self-assessment seems essentially to serve a cognitive-informational function.

The findings of the present study support the explanation in terms of self-assessment motives only for the relation between performance approach goals and overestimation, but not for the relation between mastery goals and accuracy. To the best of our knowledge, no study has yet examined how achievement goals are related to self-assessment motives by directly assessing the different motives for self-evaluation. Thus, future research may clarify what motivates students oriented towards different achievement goals in their self-assessment process.

7.5. Effects of bias in self-assessment of competence on performance

A further purpose of the present study was to examine how biases in self-assessment relate to academic performance. Our findings showed that only the grades of students who overestimated their competence progressed from the second to the third trimester. These results are in line with some previous findings (e.g., Lopez et al., 1998; Martin & Debus, 1998) but not with others (e.g., Robins & Beer, 2001). Our finding thus supports researchers' postulates about the benefits of overestimation (e.g., Bandura, 1993; Taylor & Brown, 1988). It must be noted however, that in the present sample, the students who overrated their math competence had the lowest average achievement at Trimester 2 compared to the other students. They thus had more margin for improvement than students who accurately estimated or underestimated their competence. Furthermore, given that our study was based on a one-time sampling, it cannot be excluded that students readjust their perceived competence to their actual math achievement and that biases change over time as a consequence. In any case, even if our results and previous findings tend to show that overestimation may have short-term benefits, it cannot be excluded that in the long term it has detrimental effects (Robins & Beer, 2001).

7.6. Conclusion

To conclude, the present study confirmed that overestimation is related to performance approach goals. However, results did not support the assumption that overestimation potentially involves long-term risks despite its short term benefits. Longitudinal studies may clarify the positive or negative consequences of overestimation as well as the possible change in biased self-assessment with time.

The relations between mastery and performance avoidance goals with biased self-assessments remain unclear in the present study. We hypothesized that the relationship between achievement goals and self-assessment is not as simple as we originally believed. Future research may enhance understanding of this relationship by including more complex indicators of perceived competence, tapping into the different information sources used by students in their self-assessment process, and by directly measuring the motives guiding this process.

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