

Mathematics anxiety and coping strategies among middle school students: relations with students' achievement goal orientations and level of performance

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Received: 11 May 2017 / Accepted: 5 February 2018 / Published online: 8 March 2018
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Abstract The purpose of this study was to explore relations between students' prior grades in mathematics, achievement goal orientations in math classes, math anxiety, and students coping strategies in math classes. Three achievement goal orientations (mastery goals, performance-approach goals, and performance-avoidance goals) and two coping strategies (problem-focused and self-protective strategies) were explored. Participants in the study were 939 middle school students. The study was designed as a cross-sectional survey. Data were analyzed by means of zero order correlations and structural equation modeling. The correlations between the three goal perspectives and between the two coping strategies were low. A mastery goal perspective strongly predicted the use of adaptive problem-focused coping strategies whereas this perspective predicted lower levels of math anxiety and less use of maladaptive self-protective coping strategies. A performance-avoidance goal perspective predicted higher math anxiety and more use of self-protective coping strategies. Performance-approach goals were not significantly related to math anxiety or to selfprotective coping strategies. However, they were weakly and negatively associated with problem-focused coping strategies. Prior math grades were positively associated with mastery goals and performance-approach goals and negatively associated with performance-avoidance goals and math anxiety. No direct associations were found between grades and the coping strategies. The associations were indirect, mediated through mastery goals, performance-avoidance goals, and math anxiety.

Keywords Math grades · Math anxiety · Math achievement goal orientation · Coping strategies

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1 Introduction

If students are given challenges in school, all students may encounter difficulties and even experience failure. When that happens, students use varying coping strategies. Some students use strategies aimed at achieving as well as possible (Skaalvik 2004), for instance by hard work, help seeking, trying to understand the study material and finding solutions to the problems they are working with (Friedel et al. 2007; Lazarus and Folkman 1984; Karabenick 2004). Other students turn to self-protective strategies such as self-handicapping, avoiding exposing themselves, and concealing their grades and their academic work (Covington 1992; Skaalvik 1995, 1999, 2004). The former strategies may be conceptualized as adaptive because they may result in better learning and increased understanding. In contrast, the self-protective strategies do not, in themselves, increase student learning and understanding. Thus, they may be conceptualized as maladaptive. If they are not combined with more adaptive strategies, they may, over time, lead to weaker academic achievements. The choice of coping strategies is therefore critical for the students learning and progress in school.

The present study examined middle school students' coping strategies in mathematics classes and if these strategies were influenced by the students' previous grades in mathematics, their achievement goal orientation, and their level of math anxiety. Associations were explored between three achievement goal orientations (mastery goals, performance-avoidance goals, performance approach goals) and two coping strategies (problem-focused strategies and self-protective strategies).

2 Theoretical framework

2.1 Achievement goal orientation

Recent motivational research has focused extensively on students' achievement goal orientations. This theoretical framework suggests that students have different reasons for engaging or not engaging in learning activities (Ames 1992; Patrick et al. 2011; Wolters 2004). Until 1996/1997 the research on achievement goal theory focused primarily on two goal perspectives: mastery goal orientation and performance goal orientation (Ames and Archer 1988; Nicholls 1983; Pintrich 2000). Mastery goals, also termed task goals, means that the students focus primarily on the task (Nicholls 1983) and that learning, understanding, and solving problems are ends in themselves (Duda and Nicholls 1992). Students who endorse mastery goals tend to see achievement as a consequence of effort and learning strategies (Ames 1992). In contrast, students who endorse performance goals, also termed ego goals, focus more on themselves, how they achieve compared to their classmates, and how they are perceived by others. The primary goal of these students is to outperform others, demonstrate superior abilities, and to be judged able (Duda and Nicholls 1992).

During the last 2 decades, researchers have discriminated not only between mastery and performance goal orientation, but also between approach and avoidance goal orientation. Several researchers first distinguished between performance-approach and performance-avoidance goals (Elliot and Harackiewicz 1996; Middleton and Midgley 1997; Skaalvik 1997a; Skaalvik et al. 1994). This distinction resulted in a trichotomous model of achievement goals: mastery goals, performance-approach goals, and performance-avoidance goals. Students who endorse performance-approach goals focus on demonstrating competence and achieving well relative to others, whereas students who endorse performance-avoidance goals focus on avoiding demonstrating incompetence or being negatively perceived by others (Skaalvik 1997a). Elliot (1999) further extended the model by discriminating between mastery-approach and mastery-avoidance goals, leading to a 2×2 framework of achievement goals. Students' goal orientations in mathematics classes were in this study conceptualized according to the trichotomous model.

Previous research indicates that the endorsement of mastery goals is associated with a number of adaptive cognitive, motivational and behavioral outcomes, for instance lower levels of anxiety, adaptive learning strategies like help seeking behavior, and recognition of the value of education (e.g., Harackiewicz et al. 2002; Lazarides et al. 2017; Meece and Miller 2001; Niepel et al. 2014; Wolters 2004). The research literature is more inconclusive regarding the association between mastery goals and achievement (see Harackiewicz et al. 2008). However, when significant associations are found between mastery goals and achievement, they tend to be positive (e.g., Lazarides et al. 2017). Performance-avoidance goals are associated with less adaptive outcomes, for example higher levels of anxiety and lower levels of achievement (Kaplan and Maehr 2007; Midgley and Urdan 2001; Niepel et al. 2014; Skaalvik 1997a). Studies of performance-approach goals report more inconsistent findings. However, several researchers report that it is related to a number of positive outcomes, for instance, effort, persistence, and performance (Church et al. 2001; Harackiewicz et al. 2002; Law et al. 2012; Niepel et al. 2014).

In an early study of achievement goals and learning strategies Elliot et al. (1999), in a sample of college students, found that mastery goals were predictive of deep processing, whereas both performance-approach and performance-avoidance goals were associated with surface processing. Deep processing included trying to understand, develop own ideas, and thinking through the topics. In comparison, Diseth (2011) found that, among psychology students, both mastery goals and performance-approach goals predicted deep processing strategies, whereas performance-avoidance goals predicted surface strategies. Diseth (2011) defined deep strategies as the use of evidence and relating of ideas, whereas surface strategies were defined by reproduction of the learning material by engaging in rote learning. Taken together, the studies by Elliot et al. (1999) and Diseth (2011) provide inconclusive results regarding the association between performance-approach goals and students' learning strategies.

2.2 Math anxiety

Math anxiety is commonly defined as a feeling of tension, apprehension, or fear related to working with mathematical problems or manipulation of numbers (Tobias 1993). In a review of research on math anxiety, Ashcraft (2002) concludes that highly math-anxious individuals are characterized by a strong tendency to avoid math, which ultimately undercuts their math competence. According to Tobias (1993) math anxiety may interfere with the solving of math problems in a wide variety of ordinary life and academic situations. Supporting this notion, Ashcraft and Krause (2007) demonstrated that the performance on a standardized math achievement test varies as a function of math anxiety. They argued that the preoccupation with one's math fears and anxieties is resource-demanding. It interferes with the working memory of math-anxious students and lowers the capacity to concentrate on math problems. A study of a large sample of undergraduate university students also revealed that negative emotions, including anxiety, was predictive of lower self-regulation (Mega et al. 2014).

2.2.1 Relations between anxiety and achievement goals

Butler (2006) argued that, by definition, concerns to demonstrate superior abilities and strivings to mask inferior abilities are salient when students pursue performance or ability goals, but not when they pursue mastery goals. Following this reasoning one might expect that performance-avoidance goals are associated with higher levels of anxiety, whereas mastery goals are predictive of lower levels of anxiety. These expectations have been supported in several studies. In a study of sixth and eighth grade Norwegian students in mathematics classes Skaalvik (1997a) found that performance-avoidance goals, which he termed "Self-defeating ego-orientation", were positively associated with math anxiety. In contrast, mastery goals were predictive of lower levels of math anxiety and performance-approach goals, which were termed "Self-enhancing ego-orientation", were unrelated to anxiety. Similarly, Pekrun et al. (2009) showed that anxiety was positively predicted by performance-avoidance goals, but not significantly related to performance-approach goals or mastery goals (see also Zusho et al. 2005). Despite these results, the relation between performance-approach goals and anxiety is inconclusive. Some researchers have also found performance-approach goals to be positively associated with anxiety (Bong 2009; Linnenbrink 2005).

2.3 Coping strategies

Students' coping strategies have been described as the cognitive and behavioral strategies that they employ to avoid or reduce negative emotions (e.g., anxiety and embarrassment) that often arise from a stressful event, such as doing poorly on a test or failing to complete a task (Friedel et al. 2007; Lazarus 1993). Friedel et al. (2007) discriminate between two main coping strategies: (a) positive or adaptive coping strategies and (b) maladaptive coping strategies. Additionally, they identify a non-

coping behavior, amplifying anxiety and worrying about what other people may think.

Adaptive coping strategies are those that may increase learning and improve a child's chances of doing better at the task in subsequent attempts. Examples of such strategies may be deep processing (see Sect. 2.1) and different aspects of self-regulation, for instance planning, help seeking, and self-evaluation. Adaptive strategies parallel what Lazarus and Folkman (1984) termed problem-focused coping. It is important to note that the motivation underlying problem-focused coping may not be limited to reduce anxiety and embarrassment. The motivation may also be to learn, understand, and solve the problems at hand, which characterizes a mastery goal orientation (Skaalvik 2004). A mastery goal orientation is a general orientation towards learning, understanding, and solving problems (Duda and Nicholls 1992). I therefore expected a mastery goal orientation to be positively associated with problem-focused coping strategies following failure.

Maladaptive coping strategies are strategies that aim to direct other peoples' attention away from the failure and from the perception that the student has low abilities. Examples of such strategies are self-handicapping, for instance procrastination and lack of effort (Covington 1992), and concealing one's results and shortcomings (Skaalvik 2004). Whereas self-handicapping strategies aim to alter how people attribute one's own failures, concealing strategies aim to prevent others to be aware of one's failures and to avoid the social implications of failing (Skaalvik 1999, 2004). Also, self-handicapping strategies are initiated prior to the learning process or prior to receiving any evaluation. One may therefore assume that it is affected by the students' mastery expectations or self-efficacy. In contrast, concealing the results is initiated after conducting the task or receiving the results. An assumption underlying both these self-protective strategies is that maintenance, restoration or attainment of self-worth and avoidance of negative self-perceptions are major motivational goals (Covington 1992; Skaalvik 1997b). Nevertheless, self-protective strategies such as low effort and concealing one's results are maladaptive because they do not increase the likelihood that the student will improve or do better next time (Covington 1992). Students who endorse performance goals tend to be preoccupied with themselves and how they are perceived by others. In particular, a performance-avoidance goal orientation may lead to anxiety and release self-protective mechanisms when one is experiencing challenges and failure. I therefore expected a positive association between performance-avoidance goals and maladaptive, self-protective coping strategies.

The expectations of associations between students' goal orientations and their coping strategies are partly supported in a study of 1021 students in middle school (Friedel et al. 2007). In a SEM analysis Friedel et al. (2007) found that mastery goals were positively and strongly related to what they termed positive coping ($\beta = .71$) and that performance-approach goals were negatively but weakly related to positive coping ($\beta = -.09$).

2.4 The present study

The purpose of this study was to explore relations between students' grades in mathematics, their math-related achievement goals, math anxiety and coping strategies in mathematics classes. Based on the theoretical framework presented above, a theoretical model that guided the empirical study was developed (Fig. 1). Math grades was expected to positively predict mastery goals and performance-approach goals and to be negatively associated with performance-avoidance goals (see for instance Lazarides et al. 2017; Skaalvik 1997a).

Math anxiety was expected to be positively associated with performance-avoidance goals and negatively associated with mastery goals. Based on prior research showing inconclusive and contradictory results regarding performance-approach goals no particular direction of relation between performance-approach goals and math anxiety was expected.

I expected that students' general goal orientations in math would predict their coping strategies following failure. I expected that mastery goals would be positively associated with problem-focused coping strategies and negatively associated with self-protective coping strategies—both directly and indirectly through math anxiety. Performance-avoidance goals were expected to be positively associated with self-protective coping strategies and negatively associated with problem-focused strategies. These relations were also expected, in part, to be mediated through math anxiety. Because prior research shows contradictory results for performance-approach goals, this goal perspective was not expected to be significantly associated with math anxiety or with self-protective coping strategies. However, a positive association was expected with problem-focused coping.

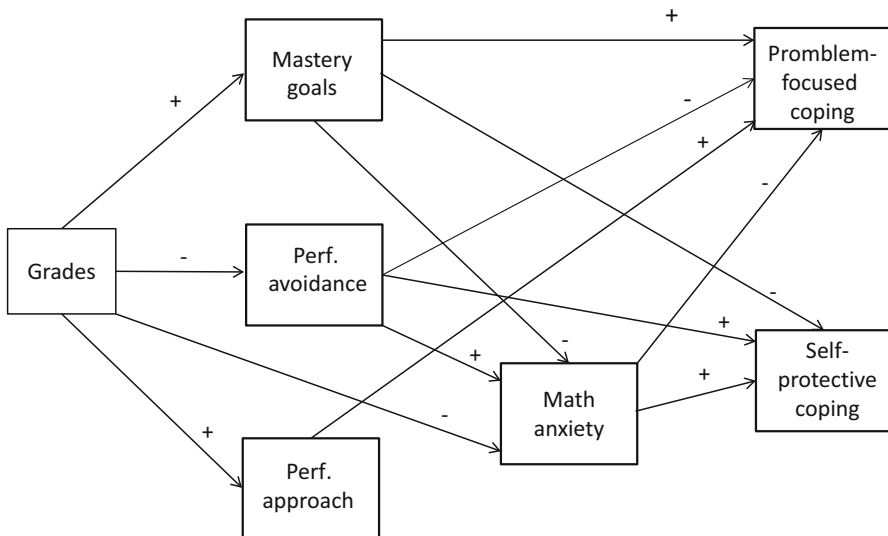


Fig. 1 Theoretical model of relations between the variables

3 Method

3.1 Participants

Participants in the study were 939 students in five middle schools (grade 8–10) in a large city in Norway. The sample consisted of 50.7% female and 49.3% male students. The data were collected by means of a questionnaire administered in the school classes by research assistants. The students did not write their names on the questionnaire and the questionnaires were collected on-site by the research assistants to ensure the students that they were anonymous. Prior to the data collection the students were informed that the aim of the study was to explore their experiences of mathematics in school. They were also told that participation was voluntary. The parents were also informed about the data collection and given the opportunity for their children not to participate. The questionnaire, the procedure, and ethical considerations were approved by the Norwegian Centre for Research Data (NSD). The study was supported economically by the Department of Education at the University of Science and Technology (copying of questionnaires, stamps, and scanning of the data) and there are no conflicts of interests.

3.2 Instruments

The students' *goal orientations* were measured by a 14-item goal orientation scale. The items were modified from the general School Goal Orientation Scale (Skaalvik 1997a) to focus on mathematics. Examples of items are: "In mathematics it is important for me to learn something new" (mastery goals), "In mathematics I try to do better than other students in my class" (performance-approach goals), and "In mathematics, it is important for me to avoid looking stupid" (performance-avoidance goals). Responses were given on a 5-point scale from *strongly disagree* (1) to *strongly agree* (5). Cronbach's alpha for the three scales were .82, .83, and .87, respectively.

Math anxiety was defined as an affective variable constituted by a feeling of tension, apprehension, or fear when working with mathematics (Tobias 1993). It was measured by a previously tested Math Anxiety Scale (Skaalvik 1997a) consisting of five items. The scale focuses on the emotional dimension of anxiety. Examples of items in the scale are as follows: "I am tense in mathematics lessons", and "I am nervous in mathematics lessons". Responses were given on a 5-point scale from *strongly disagree* (1) to *strongly agree* (5). Cronbach's alpha for the scale was .89.

Two *coping strategies* were measured in this study: a problem-focused strategy and a self-protective strategy. The problem-focused strategy emphasized trying to understand the problem and to figure out what went wrong, in order to solve the problem and to do better next time. Problem-focused coping was measured by a 3-item scale modified from a positive coping scale developed by Friedel et al. (2007). In this study the self-protective strategy focused on avoiding being negatively perceived by other students by concealing one's results. The items

measuring a problem-focused coping strategy were introduced by the following stem: “If you are working with math problems and fail to solve them, what do you do?” An example of an item measuring problem-focused coping is: “I try to understand what went wrong so that I can do better next time”. An example of an item measuring self-protective coping is: “I hide [conceal] my test results”. Responses were given on a 5-point scale from *never* (1) to *always* (5). Cronbach’s alpha for the two scales were .75 and .78, respectively.

3.3 Data analysis

The data were analyzed by means of structural equation modeling (SEM analysis) by means of the AMOS 22 program.

4 Results

Table 1 shows zero order correlations between the study variables as well as standard deviations and Cronbach’s alphas. Students’ grades were positively associated with mastery goals and performance-approach goals end negatively, but weakly with performance-avoidance goals ($r = .45$, $.28$, and $-.11$, respectively). Grades were also negatively associated with anxiety ($r = -.43$) and self-protective coping strategies ($r = -.31$), and positively associated with problem-focused coping strategies ($r = .35$). Performance-approach and performance-avoidance goals were positively and moderately associated ($r = .34$). Mastery goals were positively related to performance-approach goals ($r = .30$) but not significantly related to performance-avoidance goals ($r = -.04$). Anxiety correlated negatively with mastery goals ($r = -.36$) and positively with performance-avoidance goals ($r = .65$) and problem-focused coping strategies ($r = .13$).

Table 1 Zero order correlations, statistical means, standard deviations, and Cronbach’s alphas

Variables	1	2	3	4	5	6	7
1. Grades	–	.45***	–.11***	.28***	–.43***	.35***	–.31***
2. Mastery goals		–	–.04	.30***	–.36***	.65***	–.37***
3. Perf. avoid goals			–	.34***	.36***	–.09**	.52***
4. Perf. appr. goals				–	–.08*	.13***	.02
5. Anxiety					–	–.33***	.49***
6. PF coping						–	–.30***
SP coping							–
Mean	3.85	13.49	9.76	6.81	5.31	11.21	11.35
Standard deviation	1.13	3.62	4.31	3.00	2.67	2.65	4.31
Alpha	–	.82	.83	.87	.89	.75	.78

Perf. avoid goals = performance-avoidance goals, Perf. appr. goals = performance-approach goals, PF coping = problem-focused coping strategy, SP coping = self-protective coping strategy

* $< .05$, ** $< .01$, *** $< .001$

($r = .36$). Interestingly, anxiety correlated negatively, but close to zero with performance-approach goals ($r = -.08$). The two coping strategies correlated moderately and negatively ($r = -.30$). Problem-focused coping was positively predicted by mastery goals ($r = .65$) and negatively predicted by anxiety ($r = -.33$), whereas self-protective coping was positively predicted by performance-avoidance goals ($r = .52$) and anxiety ($r = .49$), negatively associated with mastery goals ($r = -.37$) and not significantly related to performance-approach goals ($r = .02$).

I further tested the relations among the variables by means of a SEM analysis. I first tested the theoretical model presented in Fig. 1. Secondly, a non-significant path from performance-avoidance goals to problem-focused coping strategies was deleted. Thirdly, a model including paths from performance-approach goals to math anxiety and self-protective coping was tested. These paths were not significant. Finally, a model in which grades were directly associated with the coping strategies were tested. These direct relations were also non-significant. The final empirical model, reporting standardized regression weights, is displayed in Fig. 2. Non-significant paths are not included in the figure. The final model had good fit to the data ($\chi^2 (7, N = 939) = 16.088, p < .024, \chi^2/df = 2.298, RMSEA = .037, IFI = .995, CFI = .995, TLI = .980$).

Grades in mathematics were positively related to both mastery goals ($\beta = .45$) and performance-approach goals ($\beta = .19$), and negatively related to performance-avoidance goals ($\beta = -.24$). Grades were also negatively and directly related to math anxiety ($\beta = -.30$).

Mastery goals predicted math anxiety negatively ($\beta = -.22$), whereas performance-avoidance goals predicted anxiety positively ($\beta = .32$). Performance-approach goals were not significantly associated with anxiety. Also, mastery goals

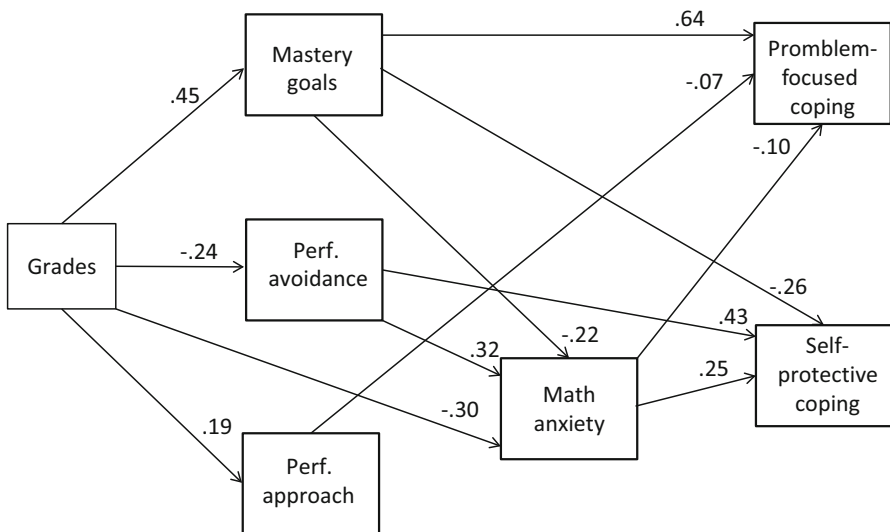


Fig. 2 Structural model of relations between the study variables

were positively and strongly related to problem-focused coping strategies ($\beta = .64$) and negatively related to self-protective coping strategies ($\beta = -.26$). Performance-avoidance goals were positively associated with both math anxiety ($\beta = .32$) and self-protective coping strategies ($\beta = .43$). Additionally, both mastery goals and performance-avoidance goals were indirectly but differently related to self-protective coping strategies, mediated through math anxiety. Performance-approach goals were negatively, but weakly associated with problem-focused coping strategies ($\beta = -.07$), but not significantly associated with math anxiety or self-protective coping strategies.

Interestingly, students' grades in math were not directly related to their coping strategies. The relations with grades were indirect, primarily mediated through mastery goals and performance-avoidance goals. The total indirect effects of grades were .31 and $-.28$ on problem-focused coping and self-protective coping, respectively.

5 Discussion and conclusion

This study explored relations between middle school students' achievement goal orientations in mathematics lessons, math anxiety, and coping strategies following failure. The SEM analysis also controlled for the effect of prior grades in mathematics. Two coping strategies were explored in this study: an adaptive problem-focused strategy focusing on trying to understand the problem and to figure out what went wrong and a maladaptive self-protective strategy focusing on concealing one's results and math problems.

The SEM analysis showed that a mastery goal orientation strongly and directly predicted the use of problem-focused coping strategies. Although the associations were weaker, a mastery goal orientation also predicted lower levels of math anxiety and less use of self-protective coping strategies. In contrast, a performance-avoidance goal orientation predicted higher levels of math anxiety and more use of self-protective coping strategies. However, the analysis showed no evidence that a performance-avoidance goal orientation would reduce the students' use of problem-focused coping strategies. A performance-approach goal orientation was practically unrelated to the coping strategies. It was not significantly associated with self-protective coping strategies and negligibly associated with problem-focused coping strategies. It was also not significantly associated with math anxiety in the SEM analysis. The association between a performance-avoidance goal orientation and the use of self-protective coping strategies was partly indirect, mediated through math anxiety. Also, the association between a mastery goal orientation and both coping strategies were partly indirect, also mediated through math anxiety. However, the indirect effects were small, whereas the direct effects were substantial.

Previous research shows that students' achievement goal orientations are differently associated with a number of outcomes, for instance anxiety and general learning strategies (see Sect. 2.1). The present study adds to these findings by showing associations between achievement goal orientations and coping strategies. This study indicates that a mastery goal orientation is adaptive not only through

promoting adaptive general learning strategies, but also through promoting adaptive responses following failure and through diminishing both math anxiety and the need for self-protective coping strategies. The result of the analysis also indicates that a performance-avoidance goal orientation increases students' need for self-protective coping strategies. This study also adds to the previous research by showing that the association between achievement goal orientations and self-protective strategies only to a small extent is mediated through math anxiety. A possible implication is that an effort to reduce math anxiety among the students only to a small extent may reduce the need for self-protective coping strategies among students who endorse a performance-avoidance goal orientation. Thus, the study highlights the need to avoid the development of performance-avoidance goal orientation among the students.

It is important to note that, although a performance-avoidance goal orientation was predictive of both math anxiety and the use of self-protective coping strategies, this goal orientation was not significantly associated with problem-solving coping strategies. Thus, the analysis showed no evidence that a performance-avoidance goal orientation leads to less use of problem-focused coping strategies. These results indicate that students who endorse performance-avoidance goals may use both self-protective and problem-focused coping strategies. This interpretation is supported by a negative but relatively weak zero order correlation between the two strategies ($r = -.30$). Thus, in this study, students' use of self-protective coping strategies may only predict nine percent of the variance in problem-focused strategies. However, the lack of a significant association between a performance-avoidance goal orientation and problem-focused coping strategies only indicates that endorsing performance-avoidance goals does not reduce the students' attempts to understand the problem and to figure out what they did wrongly. It does not tell us much about how effectively the students are able to use problem-focused strategies. The concern not to be perceived as stupid (performance-avoidance goal orientation) and the attempt to conceal one's performances are resource demanding (Ashcraft and Krause 2007) and may reduce the capacity to concentrate on the math problems. Therefore, there is a need for research that observes and describes the processes of problem-focused coping strategies among students with different achievement goal orientations. What do the students do in order to understand the math problem, what information do they seek, how do they seek the information, how well and for how long do they succeed in concentrating on the math problem?

Previous studies show inconclusive results regarding the association between a mastery goal orientation and academic achievement. Several studies have found positive associations between achievement and performance-approach goals, but inconclusive results regarding the association between achievement and mastery goals (e.g., Harackiewicz et al. 2008; Lazarides et al. 2017). The present study included midterm grades given 2 months before the data collection. Grades were therefore included as an endogenous variable in the SEM analysis. Compared to previous studies the present study revealed a relatively strong and positive association between grades and the endorsement of a mastery goal orientation. The association between previous grades and performance-approach goal orientation

was positive, but weak, and the association between grades and performance-avoidance goal orientation was negative.

Even though the students had received their midterm grades before the data collection, one should be careful not to interpret the associations with achievement goal orientation in causal terms. A reasonable assumption is that performance and achievement goal orientation affect each other in a reciprocal manner. For instance, students who perform highly and understand the study material may develop both intrinsic motivation and a mastery goal orientation. In turn, because a mastery goal orientation promotes adaptive learning strategies such as deep processing as well as adaptive coping strategies when experiencing failure, this goal orientation likely increases students' achievements. A reasonable assumption is also that the highest achieving students most strongly believe that they are able to demonstrate superior abilities, and therefore develop the strongest performance-approach goal orientation. In contrast, low achieving students have lower mastery expectations and may therefore develop a stronger performance-avoidance goal orientation.

Underlying both problem-focused and self-protective coping strategies is a striving for control. Skaalvik (1999) reasoned that underlying students' adaptive coping strategies is a striving to control the learning activities and one's achievements by developing skills, understanding the learning material, and solving the academic problems, which she termed "positive control". Positive control may take different forms or lead to different strategies, for instance asking for help, deep processing, and spending more time trying to understand the problem. Skaalvik (1999) further reasoned that underlying self-protective coping strategies is a striving to control the social situation, which she termed "negative control". Negative control may also take different forms, for instance, trying to conceal one's work, the feedback received from the teacher, and one's grades. These coping strategies were termed "negative control" because they do not promote learning or increase the students' achievements.

This study has several limitations. It was designed as a cross-sectional study. Hence, the results cannot be interpreted in causal terms. Longitudinal studies are needed. Moreover, the study was based on a tricotomous model of achievement goal orientation. Future studies of the relations between achievement goal orientation and coping strategies should be based on the 2×2 framework of achievement goal orientation. Future studies also should explore additional coping strategies. For instance, Skaalvik (2004) reported four self-protective strategies among students with reading problems: avoiding help seeking at school, concealing written work and grades, concealing the amount of time invested in homework, and avoiding situations where reading problems or lack of knowledge could be exposed (p. 120).

5.1 Conclusion

Previous studies show that a mastery goal orientation is associated with adaptive learning strategies (e.g., help seeking behavior and deep processing) whereas a performance-avoidance goal orientation is associated with less adaptive learning strategies. This study confirms and adds to these findings by showing that a mastery goal orientation predicts adaptive coping strategies following failure, whereas a

performance-avoidance goal orientation predicts self-protective, but maladaptive strategies. A performance-approach goal orientation was not strongly related to anxiety or to the coping strategies explored in this study. The study clearly indicates that differences in students' achievement goal orientations results in different coping strategies. The study also indicates that, although achievement goal orientations in math classes are predictive of math anxiety, the association between achievement goal orientation and coping strategies cannot be fully explained by the effect of achievement goals on anxiety.

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