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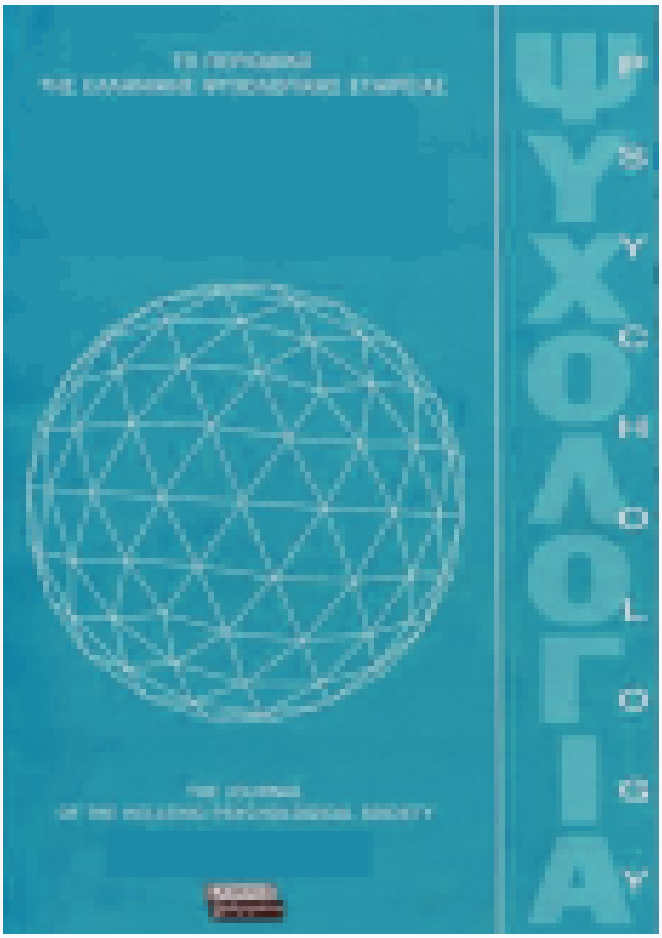

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Goal orientations and their effect on self-concept and metacognition in adolescence

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ABSTRACT This study focused on the relations between students' goal orientations towards learning, their academic self-concept in maths and their metacognitive experiences about the task at hand and task-related strategies. Five hundred and twelve students of 7th, 9th, and 11th grade participated in the study. Both genders were about equally represented. Students' performance on school mathematics and quantitative ability tasks was examined with a battery of tasks. Before and after the solution of each school mathematics task, students were asked to assess the difficulty of the task, the correctness of the solution (conceived or produced) and the effort required. Students also reported the strategies they had used for solving the tasks. Moreover, four different aspects of maths self-concept, namely, self-perception, self-esteem, self-efficacy and others' perception of one's own abilities were assessed with a questionnaire developed for this study. Finally, students' general goal orientations towards learning were assessed with Nicholls' Motivational Orientation Questionnaire. Path analysis showed that metacognitive experiences form a robust system of their own but they are also related to quantitative abilities and performance and to some aspects of students' self-concept. Task orientation was significantly related to students' self-perception and others' perception of one's self but also to the reported use of problem-solving strategies. On the contrary, ego orientation was only related to others' perception of one's own abilities, and to the reported effort needed to solve the maths tasks.

Key words. Goal orientation, Metacognitive experiences, Self-concept.

During the last fifteen years, in educational settings there is a general tendency to study achievement behavior as a function of students' cognition and motivation (Sorrentino & Higgins, 1986). When cognition is conceived of as ideas or beliefs about one's self and others dealing with tasks, strategies, or goals, we are essentially talking about what the person knows or believes about him/herself (i.e., self-concept) in a domain of knowledge, or about what the person believes about cognition and how it functions in the person him/herself and others. This means that we are talking about cognition or knowledge about one's cognition, that is, *metacognition*. Metacognition has to do with awareness of cognition as well as of goals, tasks, and strategies used by the person him/herself and the others (Flavell, 1979). Therefore, if we want to understand achievement behavior and have a better picture of the relations between cognition and motivation, we should include in our studies metacognition as well as cognition and motivation.

The purpose of the present study was to study, firstly, the effect of cognitive ability on students' motivation in the form of goal orientations and, secondly, the relations of goal orientations with students' self-concept, per-

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formance, and metacognition in the form of metacognitive experiences and metacognitive knowledge of strategies (these are aspects of metacognition, Flavell, 1979), because all these factors are involved in achievement situations.

Goal orientations. The motivational role of goal orientation in educational settings was posited in the 1980s independently by Dweck and Nicholls (Dweck & Elliott, 1983; Elliott & Dweck, 1988; Nicholls, 1989). These two approaches were later integrated into what is being called *achievement goals* (Ames, 1992; Thrash & Elliot, 2001). Goals are conscious representations of the ends students are striving to achieve and capture the person's subjective meaning of the situation, their specific purposes, the framework that organizes affective, cognitive, and behavioral responses to situational demands or failure (Dweck, 1999; Dweck & Elliott, 1983; Elliott & Dweck, 1988; Nicholls, 1989; see also Ames, 1992). Multiple goals have been identified in achievement settings but only some of them are commonly assumed to predominate, namely, learning (or mastery) goals and performance goals. The present study used Nicholls' distinction of two basic types of goal orientations in achievement settings, namely, *task orientation* and *ego orientation*, which correspond to the distinction of learning and performance goals, respectively.

More specifically, Nicholls (1989) proposed that two major goal perspectives are most commonly identified in achievement settings. The first one is the goal to achieve mastery or learning of a task and it is termed *task orientation*. Task orientation implies that one's goal is to increase one's understanding, to accomplish something one had not previously done, or to improve one's performance. Task-oriented individuals are expected to be intrinsically motivated and to strive for self-improvement by maximising their chances of learning. This claim is supported by findings showing that task orientation is associated with satisfaction with school learning (Nicholls, Pataschnick, & Nolen, 1985).

The second goal perspective identified by Nicholls (1989) is termed *ego orientation*. In this case major goal of the individual is to demonstrate superior ability relatively to others. Ego-oriented individuals aim at outperforming others, therefore, a gain in understanding or skill is not an end in itself for them but, rather, it is a means to the end of establishing one's superiority over others.

It should be pointed out that goal orientations in Nicholls', as well as in Dweck's theorising, are connected to the person's conception of ability. For Nicholls (1989) young children have an undifferentiated conception of ability, according to which effort for the mastering of a task denotes ability. With progressing age (10-11 years) a differentiation of ability from effort is achieved, in the sense that too much effort in an easy task denotes lack of ability. Yet, even in adults the undifferentiated sense of ability is evident when they try to conquer a challenging task. Ability in this case is something that can be improved through effort. Effort implies that the task is difficult, and in turn, that one is able. In contrast, ability in the differentiated form is conceived as an abstracted capacity. One infers ability when one performs as well as others with less effort. Task involvement, from this point of view, is associated with the incremental view of ability, that is, the undifferentiated conception of it, whereas ego involvement is associated with the conception of ability as an entity, that is, ability in the differentiated form.

It is important to note, however, that conceptions of ability and goal orientation are treated as motivational antecedents of behavior in achievement settings quite independently of one's self-perception of one's own ability and one's objectively measured cognitive ability. Therefore, the question is if goal orientations are related to one's cognitive ability and performance in a domain of knowledge, e.g., mathematics, but also to one's respective self-concept, that is, self-concept in mathematics. Another question pertains to the relations of goal

orientations with metacognition, that is, if goal orientations are related to the person's estimates of their cognitive processing and of their strategy use.

Goal orientations, cognitive ability and performance. The formation of goal orientations, according to Nicholls (1989, 1990), is a process that involves not only changes in children's cognitive abilities but also changes in school environment and activities, in the practices of academic evaluation, and in the relations between the students and between students and teachers (Oerter, 1989; Rosenholtz & Simpson, 1984). Therefore, no specific relationship is predicted between students' cognitive ability and goal orientations. The same regards the relationship between goal orientations and performance. Vanderstoep, Pintrich, and Fagerlin (1995) found that goal orientations did not differ between students of different level of performance.

Goal orientations and self-concept. Students' academic self-concept is another factor related to academic achievement. It creates a relatively stable internal frame of reference which is used for interpreting and organising experiences and for directing behavior. Today, there is general agreement that self-concept is a multidimensional, hierarchical, and multifaceted dynamic structure (Byrne, 1996; Harter, 1990; Markus & Wurf, 1987; Marsh, Byrne, & Shavelson, 1988). One of the dimensions of one's self-concept is academic self-concept which comprises various more narrow ones, such as self-concept in mathematics, physics, language, etc. Each of these self-concepts has a number of different facets or aspects. For example, there is a more cognitive aspect represented by *self-perception*, which involves beliefs about one's present state of abilities; an affective aspect, that is, *self-esteem*, which involves feelings of self-acceptance and self-liking; an expectancy component which captures one's expectations of effectance, that is, one's ideas/beliefs about his/her capability to perform specific tasks. This is the *self-efficacy* aspect of self-concept. Finally, there is the person's conception of how important others perceive one's abilities. This aspect can be called *others' perception of one's ability* (Dermitzaki & Efklides, 2000). Research has documented the above different aspects of the self (Byrne, 1996; Dermitzaki & Efklides, 2000; Markus & Wurf, 1987; Pajares & Miller, 1994).

With respect to the relations of the various aspects of self-concept with goal orientations, task-oriented students are expected to have a quite precise conception of their competencies, that is, self-perception in the domain of interest, in our case in mathematics. They should also be able to predict their efficiency with respect to mathematical tasks (self-efficacy). And since people build their self-concept and their sense of competence based on the feedback provided by others (Mead, 1934), a relationship should also exist between one's task orientation and others' perception of one's self. No specific relation could be expected with regard to self-esteem, that is, the affect that accompanies one's self-perception, although the more successful one in his/her effort to accomplish a task is, the more one would expect to do well and the more one would be satisfied with him/herself.

In the case of ego orientation, however, a different pattern of relations is expected, because in this case, the goal is to demonstrate ability relatively to others. Therefore, the aspect of self-concept most important for them should be the others' perception of their abilities rather than self-perception or self-efficacy. The self-esteem should also be related to their outperforming the others and therefore how others react to their performance.

Goal orientations and metacognition. According to Flavell (1979), two different forms of metacognition are distinguished. The first is *metacognitive experiences*, which represent online metacognition, and reflect personal appraisals of one's own cognitive processing as it takes place. The second form of metacognition

is *metacognitive knowledge*, which is retrieved from memory and regards persons, tasks, strategies, and goals (Efklides, 2001).

Up to now, no previous research, to our knowledge, has studied the relations of goal orientations with metacognitive experiences. However, there is ground for hypothesising relations between goal orientations and metacognitive knowledge of strategies. The use of learning strategies for achieving one's academic goals is in line with the theory of goal orientations (see Thrash & Elliot, 2001) which claims that for task-oriented students failure indicates that a new strategy or additional effort is needed. In the case of ego involvement (or performance goals), however, failure suggests lack of ability. Since ability is conceived as an entity and the person is not interested in self-improvement, s/he will not use learning strategies or will use more surface ones (Ablard & Lipschultz, 1988; Lehtinen, Vauras, Salonen, Olkinuora, & Kinnunen, 1995; Meece, Blumenfeld, & Hoyle, 1988; Meece, Wigfield, & Eccless, 1990). Yet, the use of strategies in a specific task situation presupposes that the person is aware of the strategies available as well as of the need to apply them. The person has to be aware of the interruption of cognitive processing or that the outcome of the processing is not the desired or correct one. The person becomes aware of the state or outcome of his/her cognitive processing through his/her metacognitive experiences. Therefore, goal orientations could exert their effect on metacognitive knowledge of strategies through their effect on metacognitive experiences.

In recent years, research is investigating the relations of students' metacognitive experiences (i.e., feelings, judgements/estimates, ideas and thoughts about the task at hand) with cognition, affect and performance (Efklides & Vauras, 1999). Metacognitive experiences monitor cognitive processing and mediate on-line self-regulation (Efklides, 2001; Efklides, Samara, & Petropoulou, 1999).

The metacognitive experiences included in this study were feeling of difficulty, the judgement of solution correctness and the estimate of effort needed to solve the task at hand. Feeling of difficulty makes the person aware of the lack of an immediate response to the task at hand and/or of the interruption of cognitive processing. It is the aggregate of effects from affective, cognitive ability, and performance factors and it is related to other metacognitive feelings, metacognitive judgements, metacognitive knowledge, and causal attributions (Efklides, 2001; Efklides, Papadaki, Papantoniou, & Kiosseoglou, 1997, 1998; Efklides, Samara, & Petropoulou, 1999). Its particular function is to trigger control-related decisions as to effort and time to be spent on the task, as well as control-related ideas, that is, metacognitive knowledge of strategies (Efklides, 1999; Efklides, Samara, & Petropoulou, 1999; Efklides, Petropoulou, & Samara, 1999). Therefore, feeling of difficulty could mediate the effect of task orientation on strategy use.

The judgement of solution correctness, on the other hand, is related to one's confidence and satisfaction from the solution produced (Efklides, Petropoulou, & Samara, 1999) and indirectly through confidence, to causal attribution of ability (Metallidou & Efklides, 2001). From this point of view, it can be relevant to one's goal orientation and particularly task orientation in which the person is intrinsically motivated for self-improvement, and satisfaction comes intrinsically from the person's experience with the task rather than extrinsically, from others.

Finally, the estimate of effort needed to solve a problem is particularly relevant to goal orientations, because this is the attribute ego-oriented persons are sensitive to as an indicator of lack of ability. Task-oriented individuals are expected to exert effort when they believe that high effort is necessary to produce improvement. Ego-oriented individuals, on the contrary, spend reduced effort when they expect they will perform worse than others (Nicholls, Cheung, Lauer, & Patashnick, 1989). This should be reflected in their subjective estimate of effort.

Hypotheses

Following the above considerations, the hypotheses of the study were stated as follows. In this study we did not predict any differential relationship of goal orientations with performance in mathematics tasks and with students' mathematical ability (Hypothesis 1).

Task orientation will be related to self-perception and self-efficacy as well as to others' perception of one's abilities, but not to self-esteem; ego orientation will be related more to others' perception of one's abilities rather than to one's self-perception, self-efficacy or self-esteem (Hypothesis 2).

A positive relation is expected between task orientation and estimate of effort and a negative one between ego orientation and estimate of effort. No specific hypothesis could be stated as to the relations between goal orientations and feeling of difficulty and judgement of solution correctness (despite their possible relevance to ability conception) due to lack of theoretical or empirical previous evidence. Finally, task orientation is expected to be positively related to the reported use of strategies (Hypothesis 3).

Besides the effects of goal orientations on metacognition, self-concept is also expected to affect metacognition in the form of strategy use and metacognitive experiences. It has been found in the past that certain aspects of academic self-concept are positively related to students' metacognition. For example, Pintrich and DeGroot (1990) reported that self-efficacy correlated positively with students' reported use of problem-solving strategies (see also Helmke, 1988; Pintrich & Schunk, 1996). Therefore, students' self-efficacy as well as students' cognitive ability in mathematics are expected to influence the reported use of learning strategies. Self-efficacy and mathematical ability are also expected to influence students' metacognitive experiences, namely, feeling of difficulty, estimate of effort, and judgement of solution correctness along with performance (Hypothesis 4).

Method

Participants

The participants were 512 Greek students from different schools of a Greek city. The students were of 7th, 9th and 11th grades with 159, 168, and 185 participants in the respective groups. Both genders were about equally represented with 261 girls and 251 boys of middle socio-economic level, according to parental educational background. Students were examined in their regular school classes.

Instruments

Motivational orientation. Students' motivational orientation towards learning was assessed with the Motivational Orientation Questionnaire (Nicholls, 1989). The first part of the questionnaire comprised 14 items assessing students' task orientation (with 9 items) and ego orientation (with 5 items) towards learning. Students gave their answers on a 5-point scale from "strongly disagree" to "totally agree". The internal consistency of the questionnaire was satisfactory: task orientation, Cronbach' s *alpha* = .75, ego orientation, Cronbach' s *alpha* = .80.

Academic self-concept. A questionnaire tapping the participants' academic self-concept in maths was developed by the authors for the purposes of the study. The questionnaire comprised 22 items assessing four different aspects of academic self-concept: *self-perception*, *self-esteem*, *self-efficacy*, and *others' perception of one's own abilities*. Participants gave their answers on a 5-point scale from "strongly disagree" to "strongly agree". The structural validity of the questionnaire was confirmed (see Dermitzaki & Efklides, 2000). The Cronbach's *alpha* for the whole questionnaire was *alpha* = .96 whereas for each different aspect of academic self-concept was: for self-perception *alpha* = .91, for self-esteem *alpha* = .92, for self-efficacy *alpha* = .90, for others'

perception of one's own abilities *alpha* = .89.

Performance in mathematics. A set of ten school mathematics tasks was developed by the authors according to the Greek curriculum concerning maths classes in junior high school. They required participants to solve two fractions tasks, two algebraic operations tasks, two percentages tasks, two tasks of VAT calculation (Value Added Tax), and two geometry tasks.

Quantitative abilities. Students' quantitative reasoning abilities were examined with a battery of 14 tasks. Specifically, six equations tasks, four algebraic operations tasks and four proportional tasks. These are tasks not directly relevant to school mathematical tasks and they represent basic components of quantitative or mathematical reasoning (Demetriou, Platsidou, Efklides, Metallidou, & Shayer, 1991).

Metacognitive experiences. Three kinds of students' metacognitive experiences when solving the maths exercises were recorded. The participants were asked to rate on a 4-point scale the difficulty of each task, the correctness of the solution and the effort required in two time points, before and after the solution of each school maths task.

Perceived use of problem-solving strategies. A questionnaire consisting of 11 items addressed the strategies students could have used in their problem-solving. The questionnaire was developed for the purposes of the study. Rehearsal, elaboration, organisational strategies, as well as metacognitive strategies of planning, monitoring, modifying one's own cognition were included among others. After completing the mathematics test, participants were asked to rate on a 5-point scale how much they had used each strategy when solving the tasks. The Cronbach's *alpha* for the whole questionnaire was *alpha* = .73.

The differentiation and the structural validity of the above instruments were examined and presented in another study (see Dermitzaki & Efklides, 2002).

Results

In order to test the hypothesized relations between the variables of the study path analysis was employed using the EQS statistical program (Bentler, 1993). The model that best fit the data had the following fit indices: $x^2(68) = 86.760$, $p = .062$, BNFI = .980, BNNFI = .993, CFI = .996 and involved more relations than the hypothesized ones, particularly in the case of cognitive ability and performance. For demonstration reasons, the model is presented in two parts (Figures Ia and Ib).

As predicted in Hypothesis 1, students' quantitative (mathematical) abilities were not related to students' goal-orientations although a relationship was found between performance in school mathematics tasks and task-orientation (path coefficient = .24) (see Figure 1a). This may be indicative of the situational, school-specific effects on goal-orientations. Furthermore, quantitative abilities strongly influenced students' performance in school maths as expected (path coefficient = .63). They also affected students' mathematical self-concept, and more specifically the more cognitive in nature components of it, namely others' perception of one's own maths abilities (path coefficient = .12) and self perception (path coefficient = .10). Therefore, cognitive ability is directly related to one's self-concept but not to one's goal orientations. Performance on school mathematics tasks, on the other hand, was directly related both to task orientation and to self concept, and particularly others' perception of one's ability (path coefficient = .24).

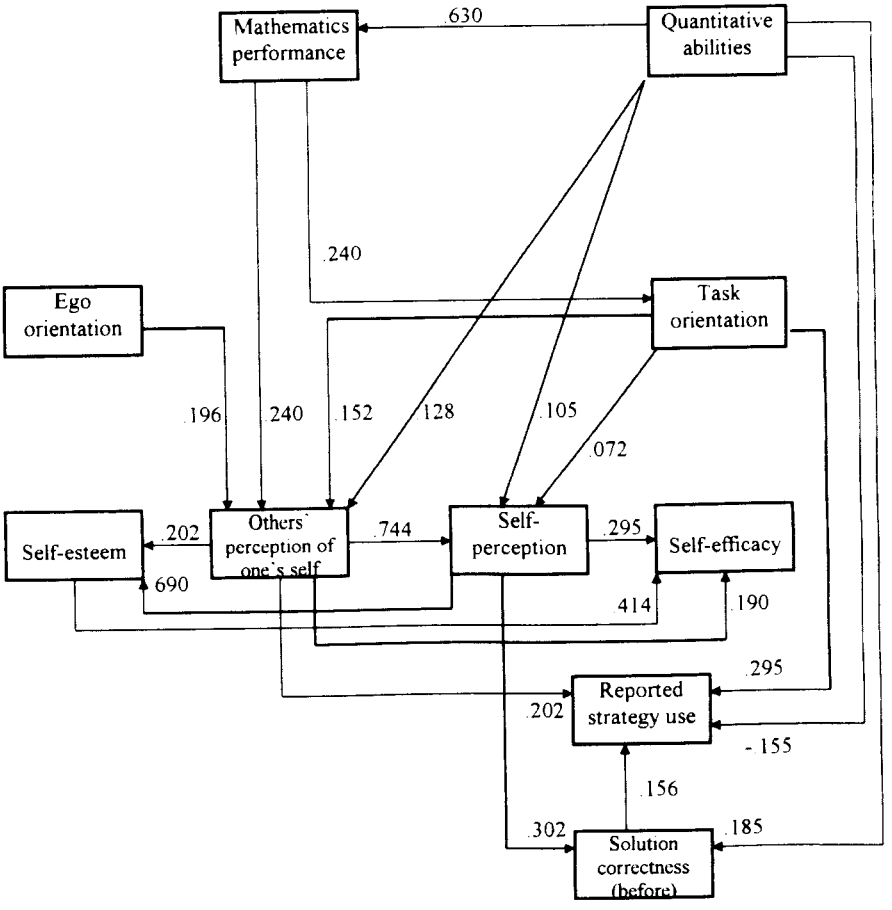
Hypothesis 2 regarded the effects of goal orientations on self-concept. As predicted, task orientation was related to self-perception (path coefficient = .07) and not to self-esteem (see Figure 1b). However, contrary to Hypothesis 2 no relationship was found with self-efficacy. The relationship of task orientation with others' perception of one's ability was also quite high (path coefficient = .15), almost as high as the

effect of ego orientation on others' perception of one's ability (path coefficient = .19). Ego orientation was related only to others' perception of one's ability as predicted (see Figure 1a).

Hypohesis 3 regarded the relations of goal orientations with metacognition.

Task orientation was found to have a strong influence on reported problem-solving strategy use (path coefficient = .29), as shown in Figure 1a. Specifically, the effect of task orientation was the main source of variance of the reported strategy use. This finding confirmed Hypothesis 3.

Ego orientation was marginally related to the estimate of effort needed to solve the task before solving the problem (path coefficient = -.05) (see Figure 1b). This finding is also in accordance with Hypothesis 3. There were no effects of goal



$x^2(68) = 86.760$, $p = .062$, NFI = .980, NNFI = .993, CFI = .996

Figure 1a

The network of relations between maths performance, quantitative abilities, academic self-concept and goal orientations.

Note. The specification 'before' in the Solution Correctness box indicates that this metacognitive experience was measured before solving the problem.

orientations on the other metacognitive experiences as predicted in Hypothesis 3.

Overall, our findings suggest, first, that goal orientations did not differentiate students' metacognitive experiences, except for the estimate of effort; therefore the effect of task orientation on strategy use was direct and not mediated by online feelings and judgments. There was, however, an indirect effect of task orientation on strategy use via self-perception and its effect on the judgment of solution correctness (see Figure 1a). Ego orientation influenced the estimate of effort only in the reports before problem solving and not after the solution of the problems. The relationship of ego orientation with estimate of effort was also negative, as predicted.

Finally, the predicted positive relationship of task orientation with the estimate of effort was not confirmed, contrary to Hypothesis 3. It is interesting, though, that once the students got involved with the solution of the problem, their estimates were determined by the demands of task-processing and the effects of ego orientation were moderated.

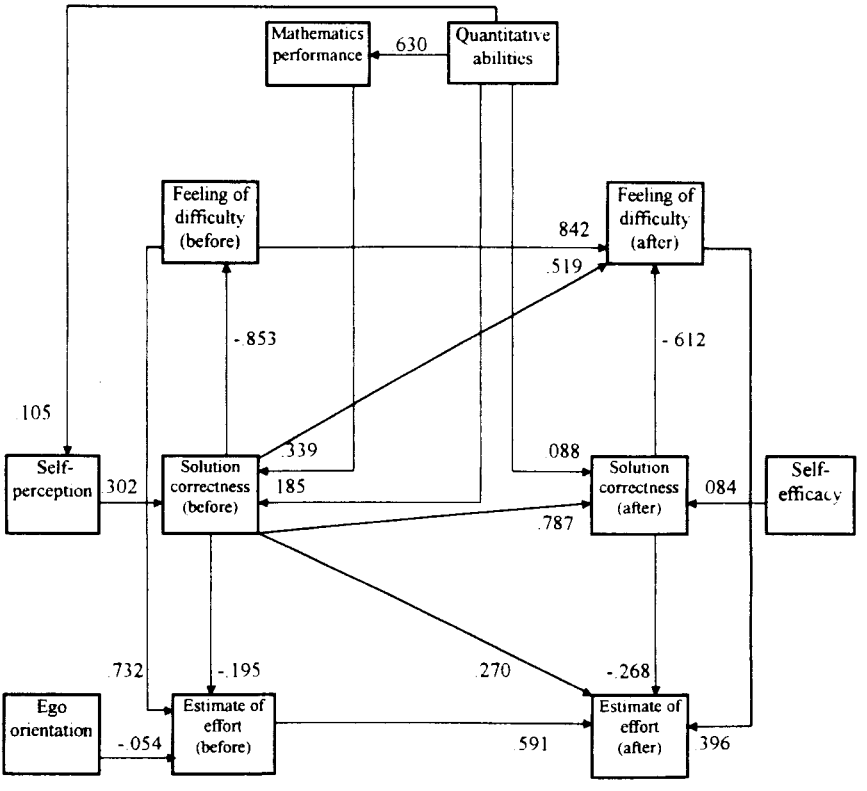
Despite the above findings, inspection of Figures 1a and 1b makes clear that the effects of cognitive (quantitative) ability, performance, and self-concept on metacognition were much stronger than the effects of goal orientations. These effects are in line with Hypothesis 4. Specifically, quantitative ability influenced both directly and indirectly via performance and self-concept (as well as task orientation) the reported use of strategies (path coefficient = -.15) and the reported metacognitive experiences and, particularly, the judgment of solution correctness (path coefficients = .18 before and .08 after the solution).

The different aspects of academic self-concept in maths influenced task-specific metacognition, although the effects were differentiated for each aspect. Specifically, others' perception of one's own maths abilities positively affected students' reported use of problem-solving strategies (path coefficient = .20). Regarding the effects of self-concept on metacognitive experiences, two aspects of self concept, namely self-perception and self-efficacy, were found to be related to the estimate of solution correctness (path coefficients = .30 and .08 respectively).

Our findings suggest that students' metacognitive experiences formed a system with strong interrelations between them. The more influential of them was the judgment of the solution correctness, not only for the other two kinds of experiences (see Figure 1b) but also for the metacognitive strategy knowledge (path coefficient = .15). The more correct the students judged the solution of the task the more they reported they used problem-solving strategies (see Figure 1a).

In conclusion, path analysis showed that goal orientations may have some effect on metacognitive experiences and metacognitive knowledge of strategies but these effects (except for task orientation and strategy use) are mainly small and indirect via self concept.

Indeed, in a series of ANOVAs, in which goal orientations were represented by two levels: high/low task orientation and high/low ego orientation as independent variables and the four aspects of self-concept as dependent variables, it was found that students with high task orientation had significantly higher scores in all four different aspects of the academic self-concept in maths (i.e., more positive self-concept) in comparison to the students with low task orientation: self-perception, $F(1, 424) = 33.12, p = .000$; self-esteem, $F(1, 424) = 30.94, p = .000$; self-efficacy, $F(1, 424) = 42.24, p = .000$; other's perception of one's ability, $F(1, 424) = 36.50, p = .000$. Also, highly ego-oriented students as compared to low ego-oriented students held more positive view of only one aspect of self-concept, namely others' perception of their own abilities, $F(1, 424) = 9.66, p = .002$. In another series of ANOVAs with metacognitive experiences as dependent variables, it was found



$x^2(68) = 86.760$, $p = .062$, NFI = .980, NNFI = .993, CFI = .996

Figure 1b

The network of relations between quantitative abilities, maths performance and metacognitive experiences in mathematics.

Note. The specification 'before' and 'after' in the Feeling of Difficulty, Solution Correctness, Estimate of Effort boxes indicates that these metacognitive experiences were measured before and after solving the problem, respectively.

that high ego-oriented students as compared to low-oriented ones estimated that less effort was needed, $F(1, 331) = 3.91$, $p = .049$. They also reported higher judgment of solution correctness, $F(1, 339) = 5.67$, $p = .018$. The same effect was found with task orientation. High task-oriented students reported higher judgment of solution correctness than low task-oriented ones, $F(1, 339) = 8.86$, $p = .003$.

Comparing the above results with the pattern of relations described in Figures 1a and 1b, it is observed that there are some additional relationships detected when performing the ANOVAs, concerning mainly task orientation.

The ANOVAs showed that task orientation was a more influential factor than what the path model had shown for all different aspects of academic self-concept as well as for the judgement of solution correctness before the solution. Ego orientation also differentiated the judgement of solution correctness before the solution.

Concerning age effects on students' goal perspectives, only in ego orientation a significant age effect was found, $F(2, 486) = 3.60$, $p = .028$. The older the students become the less ego-oriented they are and the less they believe in ability as the main cause of academic success.

Discussion

The main purpose of the present study was to investigate the relations of students' goal orientations with cognitive ability and academic self-concept in maths as well as with two different forms of metacognition, namely metacognitive experiences about the task at hand and metacognitive strategy knowledge.

Path analysis revealed the importance of domain-specific cognitive ability, in our case quantitative ability, not only for school mathematics performance but also for students' academic self-concept and metacognition. Students' quantitative ability was related to the more cognitive aspects of their academic self-concept in maths. Cognitive ability proves to be a most powerful antecedent of one's performance in problem-solving but also of one's conscious, meaning making experiences and inferences about the task at hand. However, domain-specific cognitive ability did not affect students' goal orientations although performance in school mathematics did. This finding supports Nicholls' claim that it is the school context that affects goal orientations rather than ability per se. It is the classroom context where students have external feedback about their performance and establishes the reference group which provides the basis for comparison of one's achievement relatively to others.

As stated above, the more cognitive aspects of self-concept, namely self-perception and others' perception of one's ability were affected by cognitive ability. This means that students base their self-concept not only on others' reactions towards their achievements or behavior but also on their own perception of their ability as abstracted from various contexts or situations. Although students are sensitive to significant others' perception of their abilities, they still have their own sense of competence (i.e., self-perception) which is based on personal resources. Metallidou and Efklides (2001) showed that one of the metacognitive experiences, namely, confidence in one's performance outcome, is a factor that directly feeds into the attribution of ability and self-competence.

This assumption of intrinsic sources of information that feed into one's self-concept or sense of competence is further supported by the finding that task-orientation was related to self-perception as well as to others' perception of one's ability. Task-oriented students are the ones who are intrinsically motivated and get satisfaction from working with the task. Efklides, Petropoulou, and Samara (1999) showed that satisfaction is closely related to confidence, and therefore it seems to contribute to one's sense of competence and self-perception. The relationship of task orientation with others' perception of one's ability was almost as high as the effect of ego orientation on others' perception of one's ability. This implies that even task-oriented students are interested in how significant others see them, as ego-oriented students do. The difference from ego-oriented students is that task-oriented students also have an independent source of information about their abilities (namely, self-perception) which is related to their actual abilities.

Our findings regarding the judgment of solution correctness showed that students high in task orientation judged the solution they had produced more correct than students low in task

orientation. In other words, they were more confident in their ability to carry out the task and to produce a positive performance outcome.

Highly ego-oriented students also had a high sense of solution correctness in comparison to low ego-oriented students. Their judgment of solution correctness, however, seems to come from a different source, namely, extrinsic feedback and social comparison processes rather than intrinsic sources of self-competence as suggested by the finding that ego orientation correlated only with others' perception of one's self. And because social comparison is critical for proving themselves superior to others, they decreased the reported magnitude of the estimate of effort needed for the solution of the task. Thus, they attributed to themselves high correct solution with less effort. Therefore, the overall pattern of our results fits with the goal-orientations theoretical framework.

It is also interesting to note that goal orientations were not directly related to self-efficacy. They were indirectly related to it through self-perception and others' perception of one's ability. Self-efficacy, according to Bandura (1986), expresses one's effectance expectancies but in specific situations or tasks. Our findings suggest that self-efficacy judgments are mediated by one's sense of competence as experienced by one's own self and as judged by significant others. Thus, the effects of motivational factors, such as goal orientations, are not direct on self-efficacy but through their effect on self-perception and others' perception of one's self.

The effect of goal orientations on metacognitive experiences as regards the estimate of effort and estimate of solution correctness has already been mentioned above. However, the lack of significant correlations between goal orientations and metacognitive experiences is worth exploring more in the future, because goal orientations are assumed (see Thrash & Elliot, 2001) to function both at a middle level of abstraction (as compared to the general level of motives) such as proving or improving one's self and the task-specific level, i.e., improving one's self or surpassing others at the level of the specific task. Our data suggest that goal orientations when measured as individual difference factors with a questionnaire correspond to the middle level of abstraction rather than the concrete, task-specific level at which metacognitive experiences function. Of course, there is the possibility that goal orientations influence metacognitive experiences other than the ones included in this study, but theory does not help to form more specific hypotheses in this direction.

On the other hand, there was a direct and strong effect of goal orientations on metacognition and this was the effect of task orientation on reported strategy use. It seems that task-oriented students by focussing their attention on task-processing demands, they are better aware than ego-oriented students of the strategies that are used for problem solving or for learning. Therefore, they have a rich metacognitive data base on strategies on which to draw when they are asked about strategies they may have used in problem solving. The extent to which they actually use them and under which conditions they do it (that is, task, cognitive, or metacognitive conditions) is a question for future research.

Overall, this study showed that goal orientations are related to school performance rather than cognitive ability and exert their effects on metacognitive experiences mainly through one's self-concept. The only significant effect of task orientation was on metacognitive strategy knowledge. In the case of ego orientation, the effect on metacognitive knowledge of strategies was again mediated by others' perception of one's self (see Figure 1a). This may imply that ego-oriented students are aware of strategies but realize their relevance only if some significant other uses them or points them out. Therefore, more research is needed in order to understand the exact relations between goal orientations and

strategy use. At this point, it should be noted that although path analysis allows the investigator to check for the "direction" of a relationship (path) it is performed on a correlation matrix. Therefore, one should be very careful when interpreting such results bearing always in mind that the "influences" or "effects" described are inferred by correlations among the variables.

The change of goal orientations with age is another area where more research is needed. Our data suggest a change towards higher task orientation as students become older, but the reasons why this occured is not clear. Perhaps the perceived instrumentality of school mathematics or of effort becomes evident.

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