

## **Student profiles of achievement goals, goal instructions and external feedback: Their effect on mathematical task performance and affect**

Fotini Dina and Anastasia Efklides  
Aristotle University of Thessaloniki (Greece)

The present study investigated how student profiles of achievement goals and other person characteristics along with situational factors, such as goal-orientation instructions and external feedback, influence performance, metacognitive experiences and emotions during mathematical problem solving. The study involved 870 students of seventh and ninth grade of both genders. Students completed a series of self-report questionnaires tapping attitude toward mathematics, test anxiety, mathematics self-concept, and achievement goal orientations. Ability in mathematics and performance on mathematical tasks were also measured along with metacognitive experiences and emotions, such as interest, and liking of the tasks. Hierarchical cluster analysis revealed 8 distinct student profiles with only some of them involving achievement goal orientations. A series of MANOVAS revealed significant effects of profile and treatment on task performance, on metacognitive experiences and emotions, as well as a significant interaction of profile with treatment in the case of effort ratings.

*Key words:* Achievement goal orientations, students' profiles, feedback, metacognitive experiences, interest.

*Perfiles estudiantiles de metas de logro, instrucciones de meta y retroalimentación externa: su efecto en el desempeño de tareas matemáticas y afectividad.* Este estudio investiga cómo los perfiles estudiantiles de metas de logro y otras características personales, junto con factores situacionales como las instrucciones de orientación a la meta y la retroalimentación externa influyen en el rendimiento y en las experiencias y emociones metacognitivas de los estudiantes mientras resuelven problemas matemáticos. En el estudio participaron 870 alumnos de 7º y 9º curso de ambos géneros. Los estudiantes completaron una serie de cuestionarios de auto-informe que evaluaban la actitud hacia las matemáticas, la ansiedad ante los exámenes, el autoconcepto matemático y las orientaciones de meta. También se midió la habilidad para las matemáticas y el rendimiento en tareas matemáticas junto con las experiencias y emociones metacognitivas, y el gusto por las tareas. Un análisis jerárquico de conglomerados arrojó 8 perfiles estudiantiles diferentes, y sólo algunos de ellos implicaban metas de orientación al logro. Una serie de MANOVAS puso de manifiesto los efectos significativos de perfil y tratamiento sobre rendimiento en la tarea, experiencias y emociones metacognitivas, además de una interacción significativa entre perfil y tratamiento en el caso de las valoraciones del esfuerzo.

*Palabras clave:* Metas de orientación al logro, perfiles estudiantiles, retroalimentación, experiencias metacognitivas, intereses.

Achievement goal orientations theory has led to extensive research concerning the various characteristics of goal orientations and the learning outcomes associated with them (Ames, 1992; Dweck, 1986; Nicholls, 1984). According to the normative theory of achievement goal orientations, mastery goal orientation is regarded as more adaptive than performance goal orientation, while recent research suggests that students might hold multiple goals (Pintrich, 2000b). However, there is sparse research on how achievement goal orientations when combined with other person characteristics contribute to students' performance and affective outcomes in learning situations. That is, the question is which student profiles are most important for learning and how achievement goal orientations combine with various person characteristics, such as ability in mathematics, mathematics self-concept, test anxiety, and attitude towards mathematics, to determine learning outcomes. Moreover, there is dearth of research on how student profiles interact with situational factors such as the achievement goal orientation being promoted in the classroom (e.g., goal instructions) and the external feedback provided to the students when engaged in learning.

A lot of studies have investigated which pattern of achievement goal orientations is most adaptive with respect to learning (Daniels *et al.*, 2007; Kolić-Vehovec, Rončević & Bajšanski, 2008; Meece & Holt, 1993; Pintrich, 2000b; Pintrich & Garcia, 1991; Tuominen-Soini, Salmela-Aro & Niemivirta, 2008). However, the findings are conflicting, that is, in some of the studies superiority of the combined mastery and performance goal orientation pattern was found, in others superiority of the mastery goal orientation, while in others no differences between mastery and performance goal orientation were found (Pintrich, 2000b). On the other hand, the studies on student profiles usually include only measures of achievement goal orientations (cf., Tuominen-Soini *et al.*, 2008). No study to our knowledge has included achievement goal orientations along with person characteristics such as anxiety trait, self-concept, attitude towards school subjects, and cognitive ability despite the fact that these are critical for student learning (Dina & Efklides, 2009). The present study aimed at identifying such complex profiles of student characteristics and investigate the extent to which student profiles predict learning outcomes, including task performance, metacognitive experiences –e.g., feeling of difficulty, estimate of effort, confidence (Efklides, 2001, 2006, 2008)– as well as activity-related emotions such as liking and interest (Pekrun, Goetz, Titz & Perry, 2002). Furthermore, in most studies, achievement goal orientations and person characteristics are usually compared against each other as regards their effect on learning outcomes without taking into consideration the possible impact of the learning situation, such as the goals set by the teacher and external feedback (i.e., knowledge of results). Accordingly, a second objective of the present

study was to explore the interplay between what the student bring into the learning situation with situational factors.

In what follows, we shall firstly refer to evidence regarding student profiles with respect to achievement goal orientations and then we shall present our study, in which cluster analysis was used to identify groups of students with different achievement goal orientations that are coupled with other person characteristics such as mathematics self-concept, attitude towards mathematics, test anxiety, and ability in mathematics. Next, we present the effects of student profiles on performance in mathematical tasks, and on metacognitive experiences and emotions during problem solving. Effects of goal-orientation instructions (mastery and performance) and external feedback (positive or negative) on task performance will be considered. Thus, the complexity of the factors involved in student learning will be presented and discussed.

#### *Achievement goal orientations*

Achievement goal orientations are conceptualized as the reason for seeking success in a task; they provide a framework that guides the person's interpretation of, and reaction to, various achievement situations (Dweck, 1986; Dweck & Leggett, 1988; Nicholls, 1984). Two major goal orientations have been identified in the respective research. The first is mastery goal orientation and the second is performance goal orientation; the former is also known as task or learning orientation and the latter as ego orientation (Ames & Archer, 1988; Nicholls, 1984). Mastery orientation endorses goals that promote learning and students with this orientation seek to acquire knowledge and increase their competence. In contrast, performance orientation concerns goals that promote demonstration of ability, and students with this orientation seek to outperform others, or to not show lack of ability. Mastery goal orientation is believed to be adaptive for student learning. It is associated with high self-efficacy, interest, positive attitude towards learning, effort exertion and persistence on the task and better use of metacognitive strategies (Ames & Archer, 1988; Butler, 1987; Meece, Blumenfeld & Hoyle, 1988).

These two major goal orientations have been further elaborated by introducing the approach and avoidance dimensions. According to the trichotomous achievement-goals perspective, compared to the original dichotomous one, performance-approach goal orientation may have some favorable outcomes, such as high achievement (Harackiewicz, Barron & Elliot, 1998), whereas performance-avoidance goal orientation is the least adaptive, usually associated with high anxiety, low performance and maladaptive behavior after failure, such as learned helplessness or self-handicapping. So, both mastery and performance-approach goal orientations are conceptualized as positive regarding learning, but each one leading to different

outcomes. Mastery goal orientation is usually associated with interest and positive affect (Harackiewicz, Barron, Carter, Lehto & Elliot, 1997) while performance-approach goal orientation is associated with high achievement but not necessarily with positive affect. Moreover, it seems that students often endorse more than one type of achievement goals; this is the multiple-goals perspective according to which the best characteristics of both types of approach goals (namely mastery approach and performance approach) combined might work additively and be the most adaptive for learning, better than the unique benefits of each goal orientation separately (Barron & Harackiewicz, 2001; Harackiewicz et al., 2002; Pintrich, 2000a).

However, there are researchers (Kaplan & Middleton, 2002) who claim that performance goal orientations, in any form, are not favorable for learning since any positive outcomes they might lead to, such as high achievement (Pintrich, 2000b) or cognitive engagement (Meece, Blumenfeld & Hoyle, 1988), are accompanied with negative affect (Kaplan & Maehr, 1999); thus the importance of their positive contribution is diminished. Therefore, there is no consensus yet on which goal orientation is best for learning.

#### *Student's achievement goal-orientation profiles*

One way to identify achievement goal-orientation profiles is to use cluster analytic methods. Clustering methods generally group objects by their similarity on all variables considered simultaneously (Bailey, 1975; Gore, 2000). A series of studies have used various clustering methods in order to classify students into different groups, with respect to their goal orientations (Bråten & Olaussen, 2005; Kolić-Vehovec *et al.*, 2008; Meece & Holt, 1993; Ng, 2008; Pastor, Barron, Miller & Davis, Pastor et al., 2007; Pintrich, 2000b; Riveiro, Canabach & Valle, Arias, 2001; Tapola & Niemivirta, 2008; Turner, Thorpe & Meyer, 1998; Valle *et al.*, 2003). Some of these studies have also included other variables into the cluster analysis such as strategy use, self-concept, attributions of success, or social goals (Hodge, 2008; Ng, 2008; Riveiro *et al.*, 2001; Turner *et al.*, 1998). However, there is no consensus on the number and constitution of the clusters.

Meece and Holt (1993) using hierarchical cluster analysis found three goal-orientation profiles, namely a high mastery, a combined mastery and performance, and a work-avoidant profile. The high mastery profile had higher achievement test scores as well as higher science grades than the other profiles. Turner *et al.* (1998) identified four profiles based on measures such as self-concept, affect after failure, strategy use, self-efficacy, action after failure, preference for difficulty, and individual achievement goal orientations. The profiles were labeled “learning oriented” (mastery), “success oriented”, “uncommitted”, and “avoidant”. The first two represented adaptive

student profiles for learning and the other two non-adaptive ones; unfortunately, this study did not test the profiles' relationship with task performance. Riveiro *et al.* (2001) used k-means cluster analysis and included goal orientations along with measures of cognitive, self-regulatory and motivational strategy use in the cluster analysis. No clear pattern of achievement goal orientations emerged. Valle *et al.* (2003), on the other hand, found three profiles; one with predominance of performance goals, one with predominance of multiple goals, and one with predominance of learning (mastery) goals. In their longitudinal study, Bråten and Olaussen (2005) used hierarchical cluster analysis and found three profiles labeled as "positive motivation" (mastery and interest), "moderate motivation" (moderate interest and low mastery), and "low profile" (low interest and low mastery). The drawback of this study was that performance-approach and performance-avoidance goal orientations were not included in the measures.

More recently, using two-stage cluster analysis and including additionally to achievement goal orientations social goal orientations, Ng (2008) found four profiles; mastery-focused learners, multiple-goal learners with a work focus, multiple-goal learners with a performance focus, and multiple-goal learners with multiple focuses. Hodge *et al.* (2008) used social goals in addition to achievement goal orientations and found five profiles, two of them being characterized by the level of achievement; one was a profile of low achievement with low task and ego goals and the other was of high achievement with high task and ego goals. Daniels *et al.* (2008) found four profiles using k-means cluster analysis: (a) high mastery and high performance, (b) dominant mastery, (c) dominant performance, and (d) low mastery and low performance goal orientation. However, these authors did not use the avoidance dimension of performance goal orientation. Four profiles were also found in the study of Kolić-Vehovec *et al.* (2008): (a) mastery goal orientation, (b) mastery and performance goal orientation, (c) performance goal orientation and work-avoidance, and (d) work-avoidance.

Using latent profile analysis, Pastor *et al.* (2007) tested three different factor solutions (two-, three- and four-factor) on achievement goal orientations which included both the approach and avoidance dimensions. They found that mastery goal orientation was coming out as a distinctive profile; approach goal orientations (i.e., mastery and performance) as contrasted to avoidance goals formed the basis of the other profiles. The same grouping method yielded six profiles in the Tuominen-Soini *et al.* (2008) study, that is, indifferent, mastery-oriented, success-oriented, performance-oriented (both approach- and avoidance-oriented), disengaged (low on all goal orientations), and avoidance-oriented (high avoidance-oriented, low mastery-oriented). Finally, Tapola and Niemivirta (2008) found four profiles: learning-oriented, achievement-oriented (high mastery-, high performance-, and low avoidance-oriented), performance-oriented, and avoidance-oriented.

Summarizing the results of extant studies regarding student profiles of achievement goal orientations it appears that the following profiles are among the most commonly found: (a) a predominantly mastery goal-orientation profile; (b) a predominantly performance goal-orientation profile; (c) a combination of both mastery- and performance-approach goal orientation profile and, (d) in fewer cases, a work-avoidant or a low achievement goal orientations profile. These profiles were in most studies compared to each other concerning other motivational and affective variables, but not regarding actual performance on a testing situation.

#### *Goal-orientation instructions*

Individual goal orientations are often embedded in goal-orientation contexts, such as the classroom goals (Linnenbrink & Pintrich, 2001). Goal-orientation context is formed by the teacher's instructions or the overall learning environment that emphasizes the adoption of one type of goal orientation over the others (Roeser, Midgley & Urdan, 1996). For example, when teachers emphasize improvement, students are more likely to adopt a mastery goal orientation (Midgley, Anderman & Hicks, 1995). However, not all students adopt the goal orientation of the learning environment (Newman, 1998). Linnenbrink (2005) found that individual goal orientations had a stronger effect on students' performance than the classroom goal orientation and concluded that it is essential to make a distinction between goal orientations held by the individuals and goal orientation of the classroom.

#### *Goal orientations and feedback*

Achievement goal orientations theory describes not only learning outcomes but also how individuals respond to failure. Specifically, mastery-oriented individuals perceive failure as valuable information for improvement whereas performance-oriented individuals perceive failure as lack of ability. However, there is not much work, to our knowledge, relating goal orientations with the way people react to external feedback, that is success or failure knowledge of results coming from an external source such as the teacher (or the experimenter). Less is known about how external feedback interacts with achievement goal orientations (as a person characteristic and as a contextual factor) and influences metacognitive experiences during a cognitive endeavor.

External feedback has positive (success) or negative (failure) valence. Kluger and DeNisi (1996) in their meta-analysis of studies using external feedback proposed that external feedback is useful for learning when it directs the attention of the person to the task whereas it is non-productive when it draws the person's attention to the self. Mastery (task) and performance (ego) goals represent a similar distinction as regards the focus of learning, that is, engagement with the task or with ego. Mastery-oriented

individuals seek to master the task and, consequently, direct their attention to it whereas performance-oriented individuals direct their attention to the self either seeking to prove competence or protect the self in face of failure. Previous research has shown that feedback valence had effects on student metacognitive experiences, that is, negative feedback decreased students' feelings of confidence and satisfaction and increased their feeling of difficulty; positive feedback had the opposite effect (Efklides & Dina, 2004). However, Efklides and Dina (2004) did not measure student goal orientations and, therefore, it is not known if the effects of external feedback on metacognitive experiences is due only to the valence of feedback or to its interaction with students' goal orientations. Dina and Efklides (2009) showed that external feedback, particularly the negative one, had an independent effect on state anxiety from the effect of goal orientations either as person or as context characteristic; however, in that study the authors did not use student profiles. Moreover, they tested the effects on anxiety state and not on performance.

#### *The present study*

The aim of the present study was to investigate the effect of student profiles, consisting of goal orientations and other cognitive and person characteristics, on task performance and affect (including metacognitive experiences and emotions) in a problem-solving situation where goal-orientation instructions and external feedback are provided.

#### *Research questions*

1. Which student profiles are there and which of them are associated with higher task performance? This question concerns the debate about the effectiveness of holding a combined mastery and performance-approach goal orientation, compared to holding each one separately. However, since the present study included measures of ability and other person characteristics such as test anxiety (trait), self-concept, and attitude towards mathematics, it was not possible to predict which profiles would be identified. Therefore, we could not formulate precise hypotheses about the association of student personality profiles with performance on mathematical tasks. A very general prediction was that mastery and performance-approach goal-orientation profiles will be associated with high performance, only if the profiles do not include negative characteristics, such as high test anxiety, negative attitude towards mathematics, or performance-avoidance goal orientation.

2. What are the effects of the identified student profiles on metacognitive experiences in problem-solving situations? Based on achievement goal theory and the findings of Efklides and Dina (2004), negative external feedback was expected to increase feeling of difficulty and estimate of effort, and decrease feeling of confidence,

mainly in profiles in which performance goal orientations is prevalent- particularly performance-avoidance goal orientation- or test anxiety.

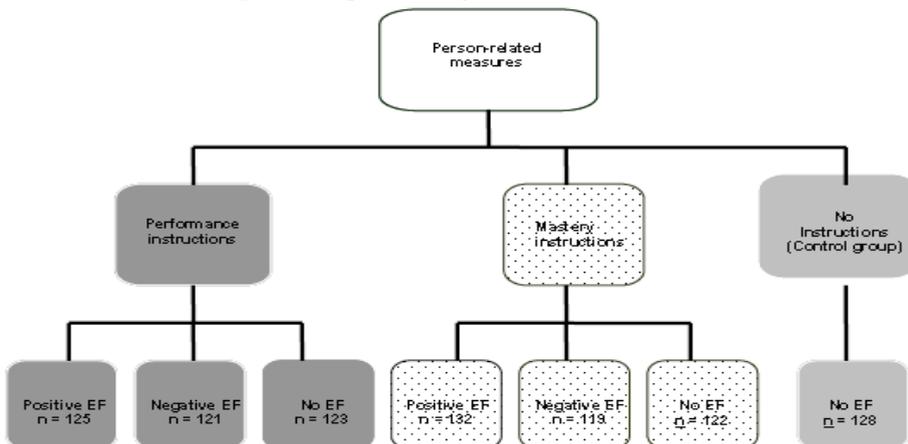
3. Do student profiles interact with goal-orientation instructions and external feedback (EF) in their effects on task performance, metacognitive experiences, and emotions? This question concerns the persistence of the effects of individual goal orientations in a context where goal-orientation instructions and external feedback are present. Again, it was not possible to formulate exact hypotheses due to the explorative nature of the study. However, based on the findings of Dina and Efklides (2009) we expected an interaction of student profiles with contextual factors such as external feedback and goal instructions.

## METHOD

### *Design*

Six groups of students (see figure 1) were formed in terms of goal instructions (mastery, performance) and external feedback (positive, negative, no EF). There was also a control group which received neither goal instructions nor external feedback. Students were tested on two consecutive occasions with the same tasks. The same procedure was followed for all groups of students. All students, except the control group, received external feedback individually after they had completed each task (see Appendix A). Before goal orientation instructions were provided, students completed a series of questionnaires tapping their mathematics self-concept, attitude toward mathematics, test anxiety, and goal orientations. Their ability in mathematics was also tested.

Figure 1. Design of the study. EF = extrinsic feedback



*Participants*

The sample ( $N = 870$ ) comprised 388 students of Grade 7 (Mean age = 12.6 years,  $SD = 0.26$ ) and 482 students of Grade 9 (Mean age = 14.5 years,  $SD = 0.44$ ) of both genders (females = 430 and males = 440) from high schools of a major Greek city. Age and gender were about equally represented in the seven groups. Thus, in the Mastery-Positive, Mastery-Negative, and Mastery-No EF groups there were 132, 119, 122 students, respectively, while in the Performance-Positive, Performance-Negative, and Performance-No EF groups there were 125, 121, and 123 students, respectively. The Control group comprised 128 students.

*Measures**Math ability test (Demetriou, Platsidou, Efklides, Metallidou & Shayer, 1991)*

A battery of 3 tests involving simple equations, arithmetic operations, and comparison of fractions were used; the total number of items was 14 (4, 4, and 6, respectively). Example items are:

1. *Simple equations*:  $m = 3n + 1$ ,  $n = 4$ ,  $m = \dots$

2. *Arithmetic operations*:  $(12 \nabla 3) * 2 = 8$ . Students were asked to replace the symbols with an operator.

3. *Comparison of fractions*: Two jars presumably containing a mixture of two fluids were presented to the students. For each jar, the ratio of the two fluids of the mixture was denoted with a set of cups (different for each jar), each cup containing either a colored or a non-colored fluid. For example, one cup's fluid was colored and that of the other two was non-colored. The students had to indicate which jar would have darker color if the fluid of the respective cups for each jar were emptied inside it.

A total score based on the sum of the scores on the 3 tests represented math ability, that is, ability in mathematics. Cronbach's alpha in the present sample was .76.

*Self-concept in mathematics (Dermitzaki & Efklides, 2000)*

A self-report questionnaire with 22 items tapped self-perception, self-efficacy, self-esteem, and perception of others' conception of one's ability in mathematics. Responses were given on a 5-point Likert-type scale. Example items are "I think I am good in mathematics", "I am pleased with my math ability", "I am expecting to do well in mathematics this year", "My classmates recognize my abilities in mathematics". A total score based on the sum of the responses on the 22 items represented mathematics self-concept; the higher the score, the more positive the self-concept is. Cronbach's alpha in the present sample was .95.

*Mathematics Attitude Scale (Aiken, 1996)*

This scale consists of 20 items measuring positive and negative attitude towards mathematics. It was adapted to Greek by Dina (2000). Responses were given on a 5-point Likert-type scale. Example items for positive and negative attitude are “Mathematics is very interesting to me, and I enjoy math classes” and “I do not like mathematics, and it scares me to have to take it”, respectively. A total score representing positive attitude towards mathematics was computed, after conversion of the scoring of the items tapping negative attitude. Cronbach’s alpha in the present sample was .93.

*Goal Orientations Scale (Midgley et al., 1998)*

It comprises 18 items, 6 for each of the three subscales measuring mastery goal orientation, performance-approach goal orientation, and performance-avoidance goal orientation, respectively. Responses were on a 5-point Likert-type scale. The 3-factor structure was confirmed in the Greek adaptation which emphasized mathematics rather than subject-free goal orientation in school (Dina, 2006). Example items are the following: For mastery goal orientation “An important reason why I do my school work is because I like to learn new things”. For performance-approach goal orientation “I would feel successful in mathematics if I did better than most of the other students”. For performance-avoidance goal orientation “It’s very important to me that I don’t look stupid in my math classes”. Cronbach’s alpha in the present sample for each subscale was .81 for mastery goal orientation, .79 for performance-approach goal orientation and .66 for performance-avoidance goal orientation.

*Test Anxiety Inventory (TAI; Spielberger, 1980)*

The TAI is a 20-item inventory that measures test anxiety as trait. Responses were on a 4-point Likert scale. The Greek adaptation confirmed the two-factor structure, namely worry and emotionality. Cronbach’s alpha in the present sample for the whole inventory was .90. For the needs of the study, a total score representing test anxiety was used.

*Metacognitive Experiences Questionnaire (MEQ; Efklides, 2002) and emotions*

There were two sets of items on the MEQ, measuring retrospective and prospective metacognitive experiences as well as interest in and liking of the task, respectively. They comprised single item measures for each metacognitive experience and each of the above two activity-related emotions, namely interest in and liking of the task, before and after problem solving. Responses were on a 4-point Likert-type scale. The MEQ included items that assessed the feeling of difficulty (FOD), estimate of effort

(EOE), estimate of solution correctness (EOC), feeling of confidence (FOC), and feeling of satisfaction (FOS). The last two metacognitive experiences were measured only after problem solving. The items were the following: for interest “How interesting is (was) the task?”; for *liking* “How much do (did) you like the task?”; for *feeling of difficulty* “How much difficulty do (did) you feel?”; for *estimate of effort* “How much effort do (did) you (need to) invest on the task?”; for *estimate of solution correctness* “How correctly do you think you can (did you) solve this task?”; for *feeling of confidence* “How confident are you that you solved correctly the task?”; for *feeling of satisfaction* “How satisfied are you with the task solution you provided?”

#### *Mathematical tasks*

Students had to solve three mathematical tasks of increasing difficulty, namely, Task 1, Task 2, and Task 3. Objective task difficulty was determined in terms of the conceptual demands of each task. Task 1 required knowledge of fractions, specifically comparison of fractions. Students were presented with 5 fractions having different numerators and denominators and were asked to place them in order of magnitude. Task 2 required knowledge of the concept of area (measurement of the area of a triangle with or without conversion of measurement units, i.e., from dm to cm or m). Task 3 required knowledge of the concept of area as well as of percentage. Students were presented with a complex figure, comprising of orthogonal parts, with two squares embedded in it covering part of its whole area. Students were asked to calculate the orthogonal figure’s area as well as the percentage of area covered by the two squares embedded in it.

#### *Procedure*

Students were tested in their classrooms during regular school hours. Goal orientation instructions were given orally and were the same for all students in a classroom. As soon as a student of the EF groups finished working on a mathematical task, she/he notified the Experimenter who gave EF on the student’s task performance. The first phase of the first testing occasion, when person-related measures were administered, and the second phase, in which the mathematical tasks and ME were measured were completed on the same day with a break between the two phases. The second testing, when the same mathematical tasks were administered for a second time, took place about three weeks after the first.

#### *Analytical method*

In the present study hierarchical cluster analysis was used because we wanted to explore the possible combinations of person characteristics with individual goal

orientations. This was done because there was no theoretical rationale upon which to base a predefined number of clusters. Following cluster analysis, analyses of variance were conducted to test the effects of the identified student profiles, goal instructions and external feedback on task performance, metacognitive experiences, and emotions.

## RESULTS

### *Variable preparation and analysis*

As described in the Method, students solved three mathematical problems in two different testing occasions. Also, they answered questions on their metacognitive experiences and emotions before and after solving each task. To simplify analyses and results, one mean score of task performance was computed for each testing occasion. Likewise, one mean score was computed for each metacognitive experience and emotion for each testing occasion.

### *Student profiles*

To determine the achievement goal-orientation profiles of our sample, a hierarchical cluster analysis was performed using Ward's method with Squared Euclidean distance. All scores were standardized through z-transformation before they were entered into the cluster analysis. Seven variables were included in the analysis; specifically, math ability, mastery goal orientation, performance-approach goal orientation, performance-avoidance goal orientation, mathematics self-concept, attitude towards mathematics, and test anxiety.

The criterion for interpretation of a cluster characteristic as high or low within each cluster was a z score of  $\pm 0.5$ . Following this criterion, a z value above +0.5 was classified as high and a z value below -0.5 was classified as low. However, the labels "high"/"low" are relative rather than absolute. This means that a characteristic labeled as high or low is high/low compared to the other clusters and not in terms of distance from the mean.

An eight-cluster solution was accepted as the most meaningful by evaluating the generated agglomeration schedule and the explanatory power of the clusters regarding their most prominent characteristics. The Z scores and the unstandardized means and standard deviations of each cluster are presented in table 1.

Following the suggestion of Aldenderfer and Blashfield (1984) for validating the cluster solution with significance tests on external variables not included in the cluster analysis, a MANOVA was performed with clusters as between subjects factor and students' school grades in mathematics and in language as the dependent variables. The multivariate effect of cluster was significant, Pillai's = .28,  $F_{(14,1720)} = 20.011$ ,  $p < .001$ ,

partial  $\eta^2=.14$ . The univariate effects were also significant,  $F_{(7,867)}=45.839$ ,  $p<.001$ , partial  $\eta^2=.27$ , for mathematics grade, and  $F_{(7,867)}=19.948$ ,  $p<.001$ , partial  $\eta^2=.14$ , for language grade (see table 2). Based on the above and after examining the composition of each cluster we can infer that each cluster had a distinct composition that was different from the other clusters and associated with different school achievement.

Table 1. Descriptive statistics of the person characteristics as a function of cluster

		Test anxiety	Attitude towards mathematics	Self-concept	Mastery goal orientation	Performance-approach goal orientation	Performance-avoidance goal orientation	Math ability
Cluster 1	z	-.11	1.17	1.06	1.09	.74	.21	.02
	M	45.48	83.86	85.67	26.00	22.60	16.66	7.52
	SD	12.15	10.47	11.99	2.63	5.10	4.85	2.87
Cluster 2	z	.65	-.14	-.05	.06	-.02	-.19	-.75
	M	55.20	60.44	63.95	20.24	18.39	14.82	9.72
	SD	10.80	11.14	14.12	4.03	3.90	3.00	2.19
Cluster 3	z	.29	-.16	.30	.13	.57	.60	-.49
	M	50.56	50.32	70.94	20.62	21.66	18.48	5.94
	SD	11.05	13.06	13.81	3.20	3.63	3.93	2.38
Cluster 4	z	.37	-.71	-.78	-.92	-.33	.13	-.31
	M	51.66	78.13	49.70	14.74	16.66	26.32	6.48
	SD	10.34	11.11	13.55	3.96	4.12	3.55	2.59
Cluster 5	z	-.71	.85	.63	.64	-.52	-.83	1.03
	M	37.70	41.65	77.29	23.50	15.61	11.86	10.61
	SD	9.50	11.67	14.17	3.25	5.18	3.00	2.18
Cluster 6	z	1.20	-1.20	-.88	-.29	.88	1.40	-1.07
	M	62.30	44.40	47.86	18.30	23.37	22.11	4.19
	SD	9.86	11.53	12.81	5.19	5.40	3.64	2.30
Cluster 7	z	-.66	-1.04	-1.26	-1.66	-1.37	-.94	-.12
	M	38.41	62.44	40.25	10.61	10.92	11.32	7.07
	SD	9.48	12.81	12.63	2.92	2.67	3.05	2.17
Cluster 8	z	-1.08	-.03	-.54	.03	-.27	-.38	-.48
	M	46.87	63.01	54.37	20.09	17.01	13.95	6.00
	SD	12.84	17.73	10.47	2.75	3.85	3.16	1.72

Table 2. Means and standard deviations of mathematics and language school grades as a function of cluster

Cluster	Mathematics grade		Language grade	
	M	SD	M	SD
Cluster 1	17.00	2.32	16.71	2.20
Cluster 2	16.42	2.56	16.24	1.87
Cluster 3	15.35	2.90	15.23	2.48
Cluster 4	14.20	3.15	14.80	2.50
Cluster 5	17.89	1.85	16.82	1.84
Cluster 6	12.72	2.99	13.58	2.91
Cluster 7	12.85	2.80	14.25	2.06
Cluster 8	14.42	2.68	14.96	2.19

Note: Range of school grades: 0-20.

The eight-cluster solution revealed eight respective student profiles.

*Profile 1 (high attitude/high self-concept/high mastery/high performance-approach).* It represents a group of students who were characterized mainly by the combination of mastery goal orientation and performance-approach goal orientation. This combination of goal orientations with high mathematics self-concept and high

attitude towards mathematics shows that the students had multiple goal orientations, liked school learning and have high academic attainment in mathematics and language. It included 131 students (15% of the sample).

*Profile 2 (high ability/high anxiety).* It represents a group of students who were high in math ability and in test anxiety. Their high math ability was also corroborated by their quite high academic attainment. All other person characteristics were not significant in this profile. This group included 85 students (9.7% of the sample).

*Profile 3 (high performance/low ability).* It represents a group of students who had a combination of both high performance-approach and high performance-avoidance goal orientations together with relatively low math ability. Their academic attainment was moderate, which suggests that these students were trying hard for success but were also worried about failure. This was a rather large group with 168 students (19% of the sample).

*Profile 4 (low attitude/low self-concept/low mastery).* It represents a group of students who had low attitude towards mathematics, low mathematics self-concept, and low mastery goal orientation. Their academic attainment was moderate. This group was also a large one with 178 students (20% of the sample).

*Profile 5 (high ability/high attitude/low anxiety/low performance-avoidance).* It represents a group of students who had high math ability as the predominant characteristic. Other predominant person characteristics of these students were low test anxiety, high attitude towards mathematics, and low performance-avoidance goal orientations. There was also low performance-approach goal orientation (this characteristic was marginally significant). This is the only group in which all positive person characteristics were concentrated. Their academic attainment was the highest of all clusters. It included 147 students (17% of the sample).

*Profile 6 (high performance/low ability/high anxiety/low attitude/low self-concept).* It represents a group of students who had the lowest math ability of all students, high test anxiety, and high performance-approach and, mainly, performance-avoidance orientations coupled with low attitude towards mathematics and low mathematics self-concept. Their academic attainment was low. It included 43 students (5% of the sample).

*Profile 7 (low goals/low attitude/low self-concept/low anxiety).* It represents a group of students who had all the achievement goal orientations low. Furthermore, they had low attitude towards mathematics, low mathematics self-concept, and low test anxiety. Their academic attainment in mathematics was low. It included 55 students (6.3% of the sample).

*Profile 8 (low anxiety).* It represents a group of students who had low test anxiety as the most prominent person characteristic. Students in this group had also low mathematics self-concept and marginally low math ability. Their academic attainment was moderate. It included 61 students (7% of the sample).

Summing up, there were two high ability profiles, that is, one that had all other person characteristics favorable (Profile 5) and one combined with high test anxiety (Profile 2). There were two profiles with low attitude towards mathematics and low mathematics self-concept, that is, one with low math ability (Profile 6) and one with low achievement goal orientations (Profile 7). Also, two profiles had high attitude towards mathematics, namely one in which there was a combination of high performance-approach and mastery goal orientations (Profile 1) and one in which math ability was high (Profile 5). There was one more group with performance-approach and performance-avoidance goal orientations combined with relatively low math ability (Profile 3). Both of the remaining two profiles had unique combination of person characteristics, that is, one had low attitude towards mathematics and low mathematics self-concept combined with low mastery goal orientation (Profile 4) and the other had low test anxiety (Profile 8). It can be concluded, then, that achievement goal orientations are not necessary constituents of student profiles while cognitive ability, test anxiety, attitude, and self-concept are very important ones. Moreover, high attitude towards mathematics and high mathematics self-concept represent positive affective states, unlike test anxiety, which represents a negative one. Therefore, student profiles tend to be defined in terms of ability, affective state, and/or achievement goal orientations in different combinations.

#### *Effects on task performance*

To be able to determine whether treatment group (i.e., goal instructions and EF) was a better predictor of task performance than student profiles, a MANOVA were performed with treatment (7 groups in terms of instructions and EF) and profile (8 profiles) as between subjects factors and the two task performance scores (first and second testing) as the dependent variables. The MANOVA showed that the multivariate effects of treatment, Pillai's= $.27$ ,  $F_{(12,1606)}=1.861$ ,  $p<.03$ , partial  $\eta^2=.03$ , and of profile, Pillai's= $.153$ ,  $F_{(14,1606)}=9.475$ ,  $p<.001$ , partial  $\eta^2=.07$ , were significant. The univariate effect of treatment was significant only in the second testing,  $F_{(6,859)}=3.24$ ,  $p<.001$ , partial  $\eta^2=.02$ . The effect of profile was significant for task performance in both testing occasions,  $F_{(7,859)}=13.57$ ,  $p<.001$ , partial  $\eta^2=.10$  for the first testing, and  $F_{(7,859)}=19.51$ ,  $p<.001$ , partial  $\eta^2=.14$  for the second testing. The interaction of treatment with profile was not significant, Pillai's= $.111$ ,  $F_{(84,1606)}=1.126$ ,  $p<.20$ , partial  $\eta^2=.05$ .

Regarding *treatment effects*, students in the Performance-no EF group had the best task performance. As post hoc comparisons using the Bonferroni method showed, this group had significantly higher performance than that of the Mastery-no EF group and the control group, but not the other groups. Overall, performance goal-orientation instructions resulted in better task performance compared to mastery goal instructions or to no instructions at all. Furthermore, the control group had the lowest task performance among all groups. These effects show that instructions coupled with EF promote task performance compared to lack of instructions and/or EF when students solve mathematical problems with performance instructions being the most effective (see table 3).

Regarding *profile effects*, students with Profile 5 (high ability/high attitude/low anxiety/low performance-avoidance), Profile 1 (high attitude/high self-concept/high mastery/high performance-approach) and Profile 2 (high ability/high anxiety) had the best task performance among clusters in both testing occasions. Specifically, post hoc comparisons using the Bonferroni method showed that the task performance of Profile 5 was significantly higher compared to all other clusters, except for Profiles 1 and 2. Also, Profile 2 task performance was significantly higher compared to all clusters except for Profile 1. Profile 6 (high performance/low ability/high anxiety/low attitude/low self-concept) had the lowest task performance among all groups except for profile 7 (low goals/low attitude/low self-concept/low anxiety), and Profile 8 (low anxiety), which also had low task performance.

These results show that students who have high math ability and/or high mathematics self-concept and positive attitude towards mathematics had the best performance, whereas students with low math ability, low mathematics self-concept, and low attitude towards mathematics had very low task performance (see Table 3). Math ability was the most critical person characteristic for task performance; even when it was coupled with high test anxiety (Cluster 2) it was still effective in terms of task performance.

Table 3. Means (and SD) of task performance as a function of treatment and profile in the two testing occasions

	1 <sup>st</sup> testing	2 <sup>nd</sup> testing	Profile	
	Treatment		1 <sup>st</sup> testing	2 <sup>nd</sup> testing
Mastery-positive EF	1.08 (0.79)	1.01 (0.83)	Profile 1	1.15 (0.89)
Mastery-negative EF	0.96 (0.80)	1.04 (0.80)	Profile 2	1.29 (0.78)
Performance-positive EF	1.12 (0.88)	1.20 (0.90)	Profile 3	0.92 (0.73)
Performance-negative EF	1.09 (0.82)	1.12 (0.96)	Profile 4	0.86 (0.69)
Mastery-no EF	1.01 (0.78)	0.97 (0.80)	Profile 5	1.50 (0.89)
Performance-no EF	1.15 (0.88)	1.29 (0.94)	Profile 6	0.57 (0.55)
Control group	0.88 (0.70)	0.88 (0.80)	Profile 7	0.75 (0.74)
			Cluster 8	0.84 (0.61)
				0.87 (0.70)

Note: EF = external feedback.

*Effects on metacognitive experiences and activity-related emotions*

Next, MANOVAs were performed with treatment (7 groups in terms of instructions and EF) and profile (8 profiles) as the between subjects factors; metacognitive experiences (feeling of difficulty, estimate of effort, estimate of solution correctness, feeling of confidence, and feeling of satisfaction) and activity-related emotions (liking and interest) were the dependent variables, separately for each testing occasion.

*First testing occasion*

The main effect of treatment, Pillai's= $.13$ ,  $F_{(42,4860)}=2.559$ ,  $p<.001$ , partial  $\eta^2=.02$  and of profile, Pillai's= $.25$ ,  $F_{(49,5677)}=4.281$ ,  $p<.001$ , partial  $\eta^2=.03$ , were significant. The univariate tests showed that the treatment effect was significant for all metacognitive experiences but not for activity-related emotions (liking and interest) while the effect of profile was significant for all metacognitive experiences and the two emotions. Furthermore, the interaction of treatment with profile on estimate of effort was significant, Pillai's= $.13$ ,  $F_{(294,5677)}=1.271$ ,  $p<.001$ , partial  $\eta^2=.06$ .

Regarding *treatment effects*, post hoc comparisons, following the Bonferroni method, showed that the Performance-negative EF group reported the highest feeling of difficulty which was significantly higher compared to all other groups' reported feeling of difficulty, except for the Mastery-negative EF and Mastery-no EF (see table 4). The control group reported the lowest feeling of difficulty. The estimate of effort showed a similar pattern, with Performance-negative EF and Mastery-no EF groups reporting the highest estimate of effort compared to the Performance-no EF and the control group. Performance-no EF and the Mastery-positive EF groups reported the highest estimate of solution correctness compared to all groups except for the two positive EF groups and the control group. Outcome-related metacognitive experiences, namely feeling of confidence in the solution provided and feeling of satisfaction, were highest again in the Performance-no EF and in the two positive EF groups (mastery and performance). These results suggest that, with respect to feedback valence, positive EF boosted students' estimate of solution correctness and feelings of confidence and satisfaction while feeling of difficulty and estimate of effort ratings were low. This effect was evident in both positive EF groups, that is, independently of the goal-orientation instructions received. Of course, these effects were in agreement with these groups' task performance, which was high.

Regarding *profile effects*, students with Profile 5 and Profile 1 reported the highest liking and interest in the tasks. Students with Profile 1 (high attitude/high self-concept/high mastery/high performance-approach) reported liking that was significantly higher compared to all other profiles, except for students with Profile 5 (high ability/high

attitude/low anxiety/low performance-avoidance) whose liking and interest was significantly higher compared to students with Profiles 4, 6 and 7. Students with Profile 6 (high performance/low ability/high anxiety/low attitude/low self-concept) and with Profile 7 (low goals/low attitude/low self-concept/low anxiety) had the lowest self-reports of liking and interest among all clusters. Therefore, the affective states (i.e., test anxiety, attitudes towards mathematics, and mathematics self-concept) are associated with the profiles are the ones that impacted the liking and interest in the tasks rather than cognitive ability by itself or achievement goal orientations.

*Table 4.* Means (and SD) of metacognitive experiences and activity-related emotions on the three mathematical tasks as a function of treatment and testing occasion

Treatment	Liking	Interest	FOD	EOE	EOC	FOC	FOS
1st testing occasion							
Mastery-Positive EF	2.26 (0.74)	2.36 (0.70)	2.29 (0.61)	2.41 (0.63)	2.73 (0.69)	2.62 (0.78)	2.71 (0.74)
Mastery-Negative EF	2.14 (0.72)	2.20 (0.70)	2.51 (0.62)	2.64 (0.63)	2.36 (0.63)	2.08 (0.65)	2.22 (0.72)
Performance-Positive EF	2.20 (0.74)	2.24 (0.67)	2.37 (0.66)	2.52 (0.60)	2.58 (0.72)	2.50 (0.86)	2.55 (0.81)
Performance-Negative EF	2.21 (0.67)	2.34 (0.67)	2.61 (0.67)	2.66 (0.58)	2.44 (0.60)	2.15 (0.72)	2.25 (0.74)
Mastery-No EF	2.18 (0.67)	2.32 (0.66)	2.50 (0.60)	2.61 (0.59)	2.56 (0.68)	2.30 (0.73)	2.44 (0.75)
Performance-No EF	2.18 (0.76)	2.15 (0.71)	2.34 (0.60)	2.42 (0.61)	2.74 (0.69)	2.62 (0.75)	2.60 (0.86)
Control group	2.19 (0.77)	2.28 (0.73)	2.33 (0.63)	2.40 (0.57)	2.63 (0.72)	2.50 (0.79)	2.51 (0.80)
2nd testing occasion							
Mastery-Positive EF	2.03 (0.74)	2.17 (0.74)	2.25 (0.67)	2.33 (0.65)	2.66 (0.78)	2.55 (0.86)	2.61 (0.88)
Mastery-Negative EF	1.83 (0.60)	1.90 (0.65)	2.50 (0.68)	2.56 (0.68)	2.25 (0.70)	2.06 (0.86)	2.16 (0.79)
Performance-Positive EF	2.14 (0.77)	2.20 (0.74)	2.38 (0.65)	2.45 (0.61)	2.63 (0.73)	2.55 (0.79)	2.58 (0.78)
Performance-Negative EF	1.99 (0.67)	2.09 (.65)	2.68 (0.59)	2.66 (0.58)	2.29 (0.67)	2.01 (0.70)	2.08 (0.74)
Mastery-No EF	2.16 (0.68)	2.22 (0.65)	2.38 (0.64)	2.46 (0.61)	2.50 (0.71)	2.36 (0.78)	2.37 (0.74)
Performance-No EF	1.95 (0.69)	1.98 (0.67)	2.31 (0.69)	2.41 (0.69)	2.60 (0.82)	2.47 (0.92)	2.52 (0.94)
Control group	2.02 (0.80)	2.07 (0.77)	2.41 (0.72)	2.42 (0.69)	2.50 (0.77)	2.46 (0.88)	2.40 (0.84)

*Note:* EF = external feedback; FOD = Feeling of difficulty; EOE = Estimate of effort; EOC = Estimate of solution correctness; FOC = Feeling of confidence; FOS = Feeling of satisfaction.

*Table 5.* Means (and SD) of metacognitive experiences and activity-related emotions in the mathematical tasks as a function of profile and testing occasion

Cluster	Liking	Interest	FOD	EOE	EOC	FOC	FOS
1st testing occasion							
Profile 1	2.63 (0.69)	2.64 (0.66)	2.27 (0.66)	2.40 (0.61)	2.92 (0.69)	2.76 (0.78)	2.82 (0.79)
Profile 2	2.16 (0.69)	2.26 (0.70)	2.46 (0.61)	2.52 (0.65)	2.64 (0.67)	2.41 (0.81)	2.55 (0.85)
Profile 3	2.28 (0.77)	2.36 (0.74)	2.43 (0.56)	2.54 (0.59)	2.59 (0.67)	2.44 (0.78)	2.54 (0.77)
Profile 4	1.88 (0.61)	2.00 (0.61)	2.56 (0.62)	2.62 (0.62)	2.28 (0.60)	2.16 (0.73)	2.24 (0.72)
Profile 5	2.39 (0.65)	2.40 (0.60)	2.31 (0.56)	2.47 (0.55)	2.82 (0.64)	2.56 (0.85)	2.63 (0.81)
Profile 6	1.80 (0.59)	2.05 (0.65)	2.53 (0.61)	2.69 (0.59)	2.20 (0.62)	2.04 (0.66)	2.06 (0.74)
Profile 7	1.75 (0.71)	1.84 (0.67)	2.33 (0.76)	2.33 (0.75)	2.23 (0.67)	2.02 (0.78)	2.18 (0.78)
Profile 8	2.23 (0.54)	2.29 (0.57)	2.50 (0.49)	2.50 (0.49)	2.61 (0.49)	2.36 (0.60)	2.35 (0.60)
2nd testing occasion							
Profile 1	2.34 (0.78)	2.40 (0.77)	2.29 (0.70)	2.38 (0.68)	2.81 (0.80)	2.66 (0.88)	2.69 (0.84)
Profile 2	2.01 (0.61)	2.10 (0.60)	2.51 (0.68)	2.59 (0.70)	2.45 (0.72)	2.32 (0.89)	2.40 (0.89)
Profile 3	2.13 (0.81)	2.20 (0.77)	2.44 (0.67)	2.49 (0.68)	2.55 (0.73)	2.44 (0.81)	2.46 (0.81)
Profile 4	1.73 (0.60)	1.82 (0.59)	2.54 (0.71)	2.56 (0.69)	2.14 (0.69)	2.05 (0.77)	2.10 (0.77)
Profile 5	2.20 (0.67)	2.22 (0.63)	2.26 (0.58)	2.40 (0.56)	2.83 (0.68)	2.66 (0.84)	2.72 (0.83)
Profile 6	1.76 (0.60)	1.91 (0.67)	2.62 (0.66)	2.63 (0.58)	2.09 (0.61)	1.90 (0.69)	1.93 (0.73)
Profile 7	1.47 (0.55)	1.52 (0.64)	2.17 (0.72)	2.14 (0.69)	2.06 (0.72)	1.94 (0.76)	1.95 (0.75)
Profile 8	2.04 (0.43)	2.14 (0.51)	2.50 (0.56)	2.50 (0.47)	2.51 (0.51)	2.36 (0.56)	2.31 (0.55)

*Note:* FOD = Feeling of difficulty; EOE = Estimate of effort; EOC = Estimate of solution correctness; FOC = Feeling of confidence; FOS = Feeling of satisfaction.

Feeling of difficulty and estimate of effort were highest in Profile 4 (low attitude/low self-concept/low mastery) and Profile 6. Students with Profile 4 reported higher feeling of difficulty compared to those with Profiles 1 and 5. Students with Profiles 1 and 7 reported the lowest feeling of difficulty and estimate of effort, but for different reasons; in the case of Profile 1 because students had high motivation (mastery/performance-approach), and in the case of Profile 7 because they had very low motivation.

Students with Profiles 1 and 5 reported the highest estimate of solution correctness, feeling of confidence and feeling of satisfaction (see Table 5) which was in accordance with their high task performance.

The significant Treatment x profile interaction effect that was found concerned the estimate of effort. Mastery instructions without EF resulted in higher ratings of estimate of effort for students with Profile 6 and Profile 7 compared to all the other students, probably due to their low attitude towards mathematics and low mathematics self-concept. Mastery instructions did not counteract their low attitude and low self-concept, which led to increased estimate of effort. On the other hand, mastery instructions with EF (positive or negative) differentiated the two profiles. Specifically, students with Profile 7 rated estimate of effort very low, a finding which may indicate withdrawal of effort in the presence of EF; for students with Profile 6, mastery instructions with positive EF resulted in high ratings of estimate of effort whereas with negative EF in low ratings (see table 6). Therefore, despite their common low attitude towards mathematics and low mathematics self-concept, Profiles 6 and 7 responded differently to goal-orientation instructions and external EF.

Table 6. Means (and SD) of estimate of effort of Clusters 6 and 7 as a function of treatment

Treatment	Cluster 6	Cluster 7
Mastery-Positive EF	2.88 (0.37)	2.12 (0.35)
Mastery-Negative EF	2.29 (0.67)	2.17 (0.87)
Performance-Positive EF	2.45 (0.45)	2.64 (0.85)
Performance-Negative EF	3.03 (0.36)	2.33 (0.67)
Mastery-No EF	3.16 (0.55)	3.19 (0.44)
Performance-No EF	2.36 (0.61)	2.20 (0.73)
Control group	2.17 (0.68)	2.01 (0.66)
Total	2.70 (0.59)	2.33 (0.75)

*Note:* EF = external feedback.

### *Second testing occasion*

Again, both treatment and cluster main effects were significant; specifically, for treatment, Pillai's=.122,  $F_{(42,4806)}=2.374$ ,  $p<.001$ , partial  $\eta^2=.02$ , and for profile, Pillai's=.238,  $F_{(49,5614)}=4.026$ ,  $p<.001$ , partial  $\eta^2=.03$ . The univariate tests showed that both effects were significant for all metacognitive experiences, except for the effect of treatment that was not significant for liking and interest. The Treatment x profile interaction was not significant, Pillai's=.373,  $F_{(294,5614)}=1.076$ ,  $p<.183$ , partial  $\eta^2=.05$ .

Overall, in the second testing occasion, results showed as in the first testing that the activity-related emotions, namely liking and interest, were different between profiles but not between treatment groups suggesting that these two emotions are mainly affected by person characteristics and are not as much influenced by situational factors. The interaction of treatment and profile was not significant in this testing, indicating that when students are faced with the same tasks for a second time, treatment and profile effects are distinct.

## DISCUSSION

The present study explored students' achievement goal-orientation profiles when coupled with other person characteristics, such as cognitive ability, mathematics self-concept, attitude towards mathematics, and test anxiety. The assumption was that when students enter a learning situation they are bringing with them a constellation of person characteristics, and depending on the combinations of these characteristics they differentially respond to situational factors such as goal instructions and EF. Therefore, the expectation was that there should be an interaction of student profiles with situational factors, resulting in differentiated task performance, metacognitive experiences, and activity-related emotions.

Regarding the first research question about student profiles, overall, our results confirmed some of the achievement goal-orientation profiles found in respective research that used only goal-orientation measures. Specifically, a combined mastery and performance-approach goal-orientation profile (Profile 1) was found (see Daniels *et al.*, 2007; Hodge *et al.*, 2008; Kolić-Vehovec *et al.*, 2008; Meece & Holt, 1993; Pastor *et al.*, 2007). A combined performance-approach and performance-avoidance goal-orientation profile (Profiles 3 and 6) was also identified (Kolić-Vehovec *et al.*, 2008). Finally, a low achievement goal-orientations profile (Profile 7) was also revealed (Daniels *et al.*, 2007; Hodge *et al.*, 2008; Meece & Holt, 1993; Tuominen-Soini *et al.*, 2008). No mastery goal-orientations only profile was found contrary to the findings of Kolić-Vehovec *et al.* (2008), Meece & Holt (1993), Ng (2008), Pintrich (2000b), and Valle *et al.* (2003). These findings are supporting the multiple goal-orientations perspective, contrary to normative achievement goal theory that treats mastery and performance goals as orthogonal (Kaplan & Maehr, 1999. Kaplan & Middleton, 2002). On the other hand, our findings could also be interpreted as confirming the distinctiveness of goal orientations, because Profiles 3 and 6 that feature high performance goals (both approach and avoidance) were not associated with mastery goals. Therefore, it seems that mastery goals can only co-exist with performance-approach goals when there is a substratum of high attitudes towards mathematics and mathematics self-concept (e.g., Profile 1). Students with this profile,

even without the highest math ability compared to other profiles, had good task performance.

Inclusion of additional person characteristics in the cluster analysis resulted in clusters beyond the previously established ones. Eight clusters emerged with different combinations of achievement goal orientations and person characteristics identifying eight respective profiles. Our results indicated that cognitive ability is a crucial factor in the formation of student profiles and so are mathematics self-concept, attitude towards mathematics, and test anxiety. The importance of motivation as compared to math ability was found only in Profile 1, in which there was a combination of mastery and performance-approach goal orientations along with high mathematics self-concept and high attitude towards mathematics but not necessarily with high math ability (Profile 1).

Students with Profile 5 had the highest math ability, compared to all other students, high attitude towards mathematics and low test anxiety. Mastery goal orientation was also a characteristic of this profile but not as prominent as math ability. The positive attitude towards mathematics was the next predominant characteristic of this profile after math ability. Therefore this profile characterizes students who are highly capable, achieve, like what they do, and therefore they do not need to worry about how they compare to other students as performance-oriented students do. This is the difference from students with Profile 1, who like mathematics but do not have that undisputable math ability that would prevent them from not worrying about their competence. Therefore, they adopt performance-approach goals that support their effort to demonstrate their competence.

The third profile with high task performance was profile 2. Students with this profile had high math ability and high test anxiety, and none of the goal orientations was a predominant person characteristic. When comparing the goal-orientation scores of this profile with the respective scores of those with Profile 8 (see table 1), the two profiles have comparable levels of mastery, performance-approach, and performance-avoidance goal orientations. These two groups of students would most likely belong to the same goal-orientations group if there were no inclusion of test anxiety and math ability in the cluster analysis. Consequently, if based only on achievement goal orientations, it would not be possible to understand the difference in their task performance. Thus, our results suggest that although achievement goal orientations are important for student profiles, equally important is to include other person characteristics as well. Profile 2 is a very good example supporting the view that test anxiety can be a facilitating factor for performance in some students. According to Alpert and Haber (1960), test anxiety can facilitate performance in some persons but be debilitating in others.

Of the remaining profiles, Profile 6 was the profile with lowest math ability along with high test anxiety, low attitude towards mathematics, low mathematics

self-concept, and performance goals (approach and avoidance) as predominant characteristics. This profile is the opposite of Profile 3 which also had high performance goals (approach and avoidance) coupled with low math ability. Their distinctive feature was that Profile 3 did not have high test anxiety, low attitude towards mathematics, low mathematics self-concept as Profile 6 did. Students with Profile 3 also had better task performance than those of Profile 6. These results again show how seemingly similar profiles in terms of achievement goal orientations can lead to different learning outcomes. These differences can only be accounted by students' mathematics self-concept and attitude towards mathematics, that is, their affective state in relation to the subject-matter.

Profile 7 was characterized by low achievement goal orientations, as was found by previous studies; however, in the present study it was also found that this profile was also characterized by low test anxiety, low attitude towards mathematics and low mathematics self-concept.

Profiles 4 and 8 had characteristics that were not comparable to previous studies. Profile 4 included low mastery goal orientation with low attitude towards mathematics and low mathematics self-concept while in previous studies low mastery goal orientation had been found in profiles along with high performance goal orientation (cf. Meece & Holt, 1993; Pintrich, 2000b). In the present study such a combination was not found.

Finally, Profile 8, was characterized by low test anxiety and had comparable, moderate academic attainment as Profile 4. As described above, students with Profile 8, compared with those with Profile 2, had lower test anxiety and lower school grades in mathematics and language, although they had the same profile regarding achievement goal orientations. Probably Profile 8 represents a group of students who have relatively high cognitive ability but avoid getting anxious about school attainment.

Overall, with respect to task performance, our prediction that profiles not associated with negative attitude towards mathematics, performance-avoidance goal orientation, or with high test anxiety would be more successful, was confirmed, except for the case of test anxiety. High test anxiety along with high math ability may lead to high task performance, whereas low test anxiety by itself does not guarantee high performance.

#### *Student profiles and treatment effects*

As Regards the other two research questions on the possible interactions of profiles with goal instructions and external EF, the results showed that profile effects were independent from the effects of situational factors (goal instructions, EF valence) as no interaction was found between treatment and profile, contrary to our expectation. The Performance-no EF group had the best performance on the tasks compared to

Mastery-no EF and Control group that received no goal instructions and no EF. What is important about treatment effects is that performance instructions can lead to high performance even in the absence of EF, whereas mastery instructions need to be associated with positive EF in order to support task performance. However, it is worth noting that treatment effects were not significant in the first testing occasion and became visible only in the second testing. This probably indicates that students with different profiles initially responded differently to the treatment and only when it was repeated students started to be influenced by contextual factors. This stability of individual differences is further supported by the findings regarding profile effects. The differences between profiles were clear right from the first testing and remained in the second testing. This finding may explain why achievement goal instructions have only small effects even in long-term interventions (Linnenbrink, 2005).

#### *Student profiles and metacognitive experiences*

Regarding metacognitive experiences the results showed that treatment effects were found for all metacognitive experiences, except for activity-related emotions, namely liking and interest. On the contrary, profile effects were found for all metacognitive experiences including activity-related emotions. This is an interesting finding because it suggests that interest and liking during problem solving depend on relatively stable person characteristics and are not easily modified by contextual factors. Specifically, interest and liking were highest in students with Profiles 1 and 5, which are associated with high attitude towards mathematics. On the other hand, metacognitive experiences which monitor cognitive processing and its outcome are influenced by external feedback on success or failure. Outcome-related metacognitive experiences were higher in profiles with high task performance, and this is understandable. These students could monitor their performance and how correct the solution was, and this was reflected in their feeling of confidence and other outcome-related metacognitive experiences.

Finally, an interaction between treatment and profile was found in the first testing regarding estimate of effort. This is an important finding since the conceptualization of effort differs between students with different achievement goal orientations, according to normative achievement goal orientations theory (see also Efklides, Kourkoulou, Mitsiou & Ziliaskopoulou, 2006). As it was explained in the Introduction, mastery-oriented individuals see effort as a means to improve themselves while performance-oriented individuals see effort as indicative of lack of ability. We found that students with Profiles 6 and 7 varied their self-reported estimate of effort in the mastery goal-orientation instructions. Both of them reported high estimate of effort in the Mastery-No EF condition. Students with Profile 6 reported a high estimate of effort in the Mastery-Positive EF condition and a low one in the Mastery-Negative EF

condition, which means that effort is considered important in the case of success but not in the case of failure. Students with Profile 7 showed a different pattern, that is, they reported low estimate of effort in both the Mastery-Positive EF and Mastery-Negative EF conditions. It is likely that students with Profile 7 do not like external feedback, because it can reveal their low performance (or lack of ability). Thus, they lower their achievement goal orientations in general and prefer non-evaluative situations in which they themselves can decide how much effort they will exert; otherwise they withdraw effort. On the contrary, students with Profile 6 have performance goal orientations and, thus, positive external EF helps them feel that their goals were satisfied. Therefore in the context of mastery goal orientations that are not competitive and do not raise performance-avoidance tendencies, students can increase effort if they get positive EF. Of course, the estimate of effort that a person self-reports does not necessarily reflect the actual effort exerted; thus, these profiles did not achieve higher task performance in the cases they did report high estimate of effort. It might also be the case that even the increased effort was not enough to meet the task demands.

The results regarding the above profiles are a snapshot of the effects of student profiles in a specific time point and in a specific situation. Further research is necessary in order to explore the possible interplay of student profiles across age groups or situations. The origins of the formation of the various profiles and the possibility of their change is also a critical issue that was not explored in the present study.

In conclusion, the results of our study showed that person characteristics such as cognitive ability, self-concept, anxiety, and attitude related to the domains of learning besides goal orientations should be taken into account when studying achievement motivation and its effects on learning outcomes. These other person characteristics might distinguish seemingly similar groups of students in terms of personal goal orientations and, thus, explain the inconsistencies found in the literature regarding the effects of goal orientations. Furthermore, our study showed that the effects of profiles and treatment were independent, indicating that person characteristics persist and work independently of situational factors, such as external feedback and goal orientation instructions. Obviously, further research is needed to validate the profiles identified in the present study and their implications for short- and long-term implications for learning.

## REFERENCES

- Aiken, L.R. (1996). *Rating scales and checklists: Evaluating behaviour, personality, and attitudes*. London: Wiley.
- Aldenderfer, M.S. & Blashfield, R.K. (1984). *Cluster analysis*. Newbury Park, CA: Sage.
- Alpert, R. & Haber, R. N. (1960). Anxiety in academic achievement situations. *Journal of Abnormal and Social Psychology*, 10, 207-215.

- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84, 261-271.
- Ames, C. & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, 80, 260-267.
- Bailey, K. (1975). Cluster analysis. In D. Heise (Ed.), *Sociological Methodology*. San Francisco: Jossey-Bass.
- Barron, K.E. & Harackiewicz, J. M. (2001). Achievement goals and optimal motivation: Testing multiple goal models. *Journal of Personality and Social Psychology*, 80, 706-722.
- Bråten, I. & Olaussen, B.S. (2005). Profiling individual differences in student motivation: A longitudinal cluster-analytic study in different academic contexts. *Contemporary Educational Psychology*, 30, 359-396.
- Butler, R. (1987). Task-involving and ego-involving properties of evaluation: Effects of different feedback conditions on motivational perceptions, interest, and performance. *Journal of Educational Psychology*, 79, 474-482.
- Daniels, L.M., Haynes, T.L., Stupnisky, R.H., Perry, R.P., Newall, N.E. & Pekrun, R. (2008). Individual differences in achievement goals: A longitudinal study of cognitive, emotional, and achievement outcomes. *Contemporary Educational Psychology*, 33, 584-608.
- Demetriou, A., Platsidou, M., Efklides, A., Metallidou, Y. & Shayer, M. (1991). Structure and sequence of the quantitative-relational abilities from childhood to adolescence. *Learning and Instruction*, 1, 19-44.
- Dermitzaki, I. & Efklides, A. (2000). Aspects of self-concept and their relationship with language performance and verbal reasoning ability. *American Journal of Psychology*, 113, 621-638.
- Dina, F. (2000). *The interactions between cognitive and affective factors during the solution of lectical mathematical problems under the influence of positive and negative feedback to students of the 5th grade*. Unpublished diploma thesis, School of Psychology, Aristotle University of Thessaloniki, Greece.
- Dina, F. (2006). *The effect of feedback as a function of task, motivation, self, and affect*. Unpublished doctoral dissertation, School of Psychology, Aristotle University of Thessaloniki, Greece.
- Dina, F. & Efklides, A. (2009). Metacognitive experiences as the link between situational characteristics, motivation, and affect in self-regulated learning. In M. Wosnitza, S. A. Karabenick, A. Efklides & P. Nenniger (Eds.), *Contemporary motivation research: From global to local perspectives* (pp. 117-146). Goettingen, Germany: Hogrefe & Huber.
- Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist*, 41, 1040-1048.
- Dweck, C.S. & Leggett, E.L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95, 256-273.
- Efklides, A. (2001). Metacognitive experiences in problem solving. In A. Efklides, J. Kuhl & R.M. Sorrentino (Eds.), *Trends and prospects in motivation research* (pp. 297-323). Dordrecht, The Netherlands: Kluwer.
- Efklides, A. (2002). The systemic nature of metacognitive experiences: Feelings, judgments, and their interrelations. In M. Izaute, P. Chambres & P.-J. Marescaux (Eds.), *Metacognition: Process, function, and use* (pp. 19-34). Dordrecht, The Netherlands: Kluwer.
- Efklides, A. (2006). Metacognition and affect: What can metacognitive experiences tell us about the learning process? *Educational Research Review*, 1, 3-14.

- Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist*, 13, 277-287.
- Efklides, A. & Dina, F. (2004). Feedback from one's self and from the others: Their effect on affect. *Hellenic Journal of Psychology*, 1, 179-202.
- Efklides, A., Kourkoulou, A., Mitsiou, F. & Ziliaskopoulou, D. (2006). Metacognitive knowledge of effort, personality factors, and mood state: Their relationships with effort-related metacognitive experiences. *Metacognition and Learning*, 1, 33-49.
- Gore, P.H. (2000). Cluster analysis. In H.E.A. Tinsley & S.D. Brown (Eds.), *Handbook of applied multivariate statistics and mathematical modeling*. New York: Academic.
- Harackiewicz, J., Barron, K., Carter, S., Lehto, A. & Elliot, A. (1997). Predictors and consequences of achievement goals in the college classroom: Maintaining interest and making the grade. *Journal of Personality and Social Psychology*, 73, 1284-1295
- Harackiewicz, J.M., Barron, K. & Elliot, A. (1998). Rethinking achievement goals: When are they adaptive for college students and why? *Educational Psychologist*, 33, 1-21.
- Harackiewicz, J.M., Barron, K.E., Pintrich, P.R., Elliot, A.J. & Thrash, T.M. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology*, 94, 638-645.
- Hodge, K., Allen, J. B. & Smellie, L. (2008). Motivation in masters sport: achievement and social goals. *Psychology of Sport and Exercise*, 9, 157-176.
- Kaplan, A. & Maehr, M. L. (1999). Achievement goals and student well-being. *Contemporary Educational Psychology*, 24, 330-358.
- Kaplan, A. & Middleton, M.J. (2002). Should childhood be a journey or a race? A response to Harackiewicz et al. (2002). *Journal of Educational Psychology*, 94, 646-648.
- Kluger, A.N. & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, 119, 254-284.
- Kolić-Vehovec, S., Rončević, B. & Bajšanski, I. (2008). Motivational components of self-regulated learning and reading strategy use in university students: The role of goal orientation patterns. *Learning and Individual Differences*, 18, 108-113.
- Linnenbrink, E.A. (2005). The dilemma of performance-approach goals: The use of multiple goal contexts to promote students' motivation and learning. *Journal of Educational Psychology*, 97, 197-213.
- Linnenbrink, E.A. & Pintrich, P.R. (2001). Multiple goals, multiple contexts: the dynamic interplay between personal and contextual goals stresses. In S. Volet & S. Jäverlä (Eds.), *Motivation in learning contexts: Theoretical advances and methodological implications* (pp. 251-269). Amsterdam: Pergamon.
- Meece, J.L., Blumenfeld, P.C. & Hoyle, R.H. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology*, 80, 514-523.
- Meece, J. & Holt, K. (1993). A pattern analysis of students' achievement goals. *Journal of Educational Psychology*, 85, 582-590.
- Midgley, C., Anderman, E. & Hicks, L. (1995). Differences between elementary and middle school teachers and students: A goal theory approach. *Journal of Early Adolescence*, 15, 90, 113.
- Midgley, C., Kaplan, A., Middleton, M., Maehr, M.L., Urdan, T., Lynley, H.A., Anderman, E. & Roeser, R. (1998). The development and validation of scales assessing students' achievement goal orientations. *Contemporary Educational Psychology*, 23, 113-131.
- Newman, R.S. (1998). Students' help seeking during problem solving : influences of personal and contextual achievement goals. *Journal of Educational Psychology*, 90, 644-658.

- Ng, C.C. (2008). Multiple-goal learners and their differential patterns of learning. *Educational Psychology*, 28, 439-456.
- Nicholls, J.G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review*, 91, 328-346.
- Pastor, D.A., Barron, K.E., Miller, B.J., Davis, S.L. (2007). A latent profile analysis of college students' achievement goal orientation. *Contemporary Educational Psychology*, 32, 8-47.
- Pekrun, R., Goetz, T., Titz, W. & Perry, R.P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, 37, 91-105.
- Pintrich, P.R. (2000a). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology*, 25, 92-104.
- Pintrich, P.R. (2000b). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, 92, 544-555.
- Pintrich, P.R. & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In M.L. Maehr & P.R. Pintrich (Eds.), *Advances in motivation and achievement*. Vol. 7 (pp. 371-402). Greenwich, CT: JAI.
- Riveiro, J.M., Cabanach, R.G. & Valle, A. (2001). Multiple goal pursuit and its relation to cognitive, self-regulatory, and motivational strategies. *British Journal of Educational Psychology*, 71, 561-572.
- Roeser, R.W., Midgley, C. & Urdan, T.C. (1996). Perceptions of school psychological environment and early adolescents' psychological and behavioral functioning in school: The mediating role of goals and belonging. *Journal of Educational Psychology*, 88, 408-422.
- Spielberger, C.D. (1980). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Tapola, A. & Niemivirta, M. (2008). The role of achievement goal orientations in students' perceptions of and preferences for classroom environment. *British Journal of Educational Psychology*, 78, 291-312.
- Tuominen-Soini, H., Salmela-Aro, K. & Niemivirta, M. (2008). Achievement goal orientations and subjective well-being: A person-centred analysis. *Learning and Instruction*, 18, 251-266.
- Turner, J.C., Thorpe, P.K. & Meyer, D.K. (1998). Students' reports of motivation and negative affect: a theoretical and empirical analysis. *Journal of Educational Psychology*, 90, 758-771.
- Valle, A., González-Cabanach, R., Núñez, J.C., González-Pienda, J., Rodríguez, S. & Piñeiro, I. (2003). Multiple goals, motivation and academic learning. *British Journal of Educational Psychology*, 73, 71-87.

#### Appendix A. Instructions given to students

Before solving mathematical problems students received goal-orientation instructions in both testing occasions. The wording of EF matched that of the instructions so that there is consistency between goal instructions and the success or failure framing of EF. Below are the goal-orientation instructions and external EF that was given to each group.

*Mastery goal-orientation instructions and EF*

The aim of this study is to investigate the way in which students solve mathematical problems. Specifically, we are interested in giving students an opportunity to solve mathematical problems and see how they apply their knowledge to these tasks. The experience and knowledge that someone obtains while s/he is dealing with a task are very important, independently of whether the person succeeds or fails to solve the task. Please, try to solve these problems and try to find out what you can learn from this experience. When you are finished with each problem you will be informed about the mathematical knowledge required.

The feedback provided by the Experimenter was the following:

Positive EF: "You seem to have the knowledge required."

Negative EF: "You seem not to have the knowledge required."

*Performance goal-orientation instructions and EF*

The aim of this study is to investigate the way in which students solve mathematical problems. Specifically, we want to compare the performance of students and find out how many of them are going to achieve high scores. A higher score means that someone has high ability in mathematical thinking. Please, try to solve these problems correctly and without errors. When you are finished with each problem you will be informed about how you achieved as compared to the mean of students of your age.

The feedback provided by the Experimenter was the following:

Positive EF: "You achieved higher than the mean of students of your age."

Negative EF: "You achieved lower than the mean of students of your age."

*Mastery-No EF group and Performance-No EF group*

The last sentence of the respective goal instructions was omitted in the case of the groups that did not receive EF.

*Control Group*

The aim of the study is to investigate the way in which students solve mathematical problems. Please try to solve the problems you are given.

Received March, 10, 2009

Revision received June, 3, 2009

Accepted June, 25, 2009