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2 × 2 Achievement goals and achievement emotions: a cluster analysis of students' motivation

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Abstract This study sought to better understand the adoption of multiple achievement goals at an intra-individual level, and its links to emotional well-being, learning, and academic achievement. Participants were 480 Secondary Two students (aged between 13 and 14 years) from two coeducational government schools. Hierarchical cluster analysis revealed the presence of five clusters of students with significantly different achievement goal profiles. MANOVAs and ANOVA, followed by post-hoc tests showed that these clusters also differed significantly in terms of their experience of achievement emotions, use of learning strategies, and mathematics performance. The cluster with high endorsement of mastery approach goal and low endorsement of mastery avoidance goal was noted to have the most adaptive profile. The presence of a cluster of lowly motivated students was highlighted. Findings emphasised the importance of investigating achievement emotions, and how the different achievement goals combine to influence achievement-related variables.

Keywords Achievement goals · Achievement emotions · Learning strategies · Mathematics achievement · Cluster analysis

Introduction

In today's knowledge-based economy, we need a workforce with the ability to learn continuously. This suggests that the educational system should encourage students to be interested in gaining knowledge. Singapore has an educational system where students are streamed nationally according to their academic performance at the end of primary 6 into different ability streams. In a system with such high-stakes exam, it is tenable that there may be an emphasis on student's performance rather than mastery. Hence, it would be interesting to understand the motivation profile of students in such a system and its links to

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achievement-related variables. It is especially intriguing to look into the relationship between the students' motivation profile and their emotional well-being, an important but often neglected aspect.

Achievement goals

Achievement goals are related to reasons or purposes that a person pursues an achievement task (Pintrich and Schunk 1996), as well as one's standard or point of reference for evaluating one's competence or success (Elliot 1997). Recently, Elliot and his colleagues (Elliot 1999; Elliot and McGregor 2001) proposed a revision to the achievement goal theory by suggesting that the achievement goals be differentiated along two dimensions, namely, according to how competence is defined and according to how competence is valenced.

According to the 2×2 achievement goal framework (Elliot 1999; Elliot and McGregor 2001), competence may be defined differently depending on the referent standards or criteria for evaluation. When the reference is absolute, competence is determined by the requirements of the task. Success is attained when the task is completed. When the reference is intrapersonal, competence is determined by whether one fully comprehended or mastered the task. Holding either an absolute or intrapersonal reference indicates adoption of mastery goal. Mastery goal reflects an emphasis on development of competence, knowledge, and skill relative to one's prior achievement/performance. On the other hand, should the reference be normative, competence is determined by whether one outperformed others; reflective of adoption of performance goal. Performance goal highlights the emphasis on surpassing others, such as outperforming others in academic tasks in terms of grades and achievement. Success and competence was based on comparisons, using others as a point of reference. A person adopting a performance goal strives to demonstrate one's competence and superiority vis-à-vis extrinsic factors (e.g. obtaining better grades than others).

The valence dimension represents the approach–avoidance distinction. According to Elliot (2006, p. 112), approach motivation may be defined as the energisation of behaviour by, or the direction of behaviour toward, positive stimuli (objects, events, possibilities), whereas avoidance motivation may be defined as the energisation of behaviour by, or the direction of behaviour away from, negative stimuli (objects, events, possibilities). In other words, an achievement goal may focus one on attaining a positive desirable possibility or to avoid a negative, undesirable possibility (Elliot and Murayama 2008). The mastery-performance and approach–avoidance distinction thus leads to four types of achievement goals. A mastery approach goal focuses one on attaining desirable possibilities according to absolute or intrapersonal standards such as gaining competence. A mastery avoidance goal, however, focuses one on avoiding negative possibility according to absolute or intrapersonal standards such as doing worse than one has done before. In comparison, performance approach goal focuses one on attaining desirable possibilities using normative standards such as outdoing others. Performance avoidance goals focuses one on avoiding negative possibilities while holding normative standards such as avoiding being inferior to others.

It has to be acknowledged that the 2×2 framework is not accepted by all researchers in the field. There are researchers who have debated the existence and labelling of mastery avoidance goal. For instance, Deshon and Gillespie (2005) questioned the utility of the added mastery avoidance goal. They cited the lack of studies utilising the 2×2 model as compared to the trichotomous goal model (for review, see Elliot 2005). Nonetheless, initial research indicated that the four achievement goals formed four separate constructs and differentially predicted a variety of learning-related outcomes (Elliot and McGregor 2001;

Zusho and Pintrich 2000; Van Yperen 2006). More importantly, studies indicated that mastery avoidance goals are prevalent in achievement settings (e.g. Van Yperen 2006; Van Yperen and Renkema 2008) and can have deleterious effects on performance (Van Yperen et al. 2009), thus providing support for the importance of mastery avoidance goal as part of the 2×2 achievement goal model.

Achievement goals and achievement emotions

It was hypothesised that achievement goals set up a perceptual-cognitive framework for how individuals interpret achievement settings (Dweck 1986; Elliot 1997; Elliot and Pekrun 2007; Pintrich 2000). As the different achievement goals set up different interpretive frameworks, different achievement goals would likely lead to different emotional experiences (McGregor and Elliot 2002; Pekrun et al. 2006; 2009; Pekrun et al. 2002). However, educational research has largely neglected the study of emotions (Pekrun and Frese 1992; Schutz and Lanehart 2002), although emotions have been found to have important links to students' learning and achievement (Pekrun et al. 2002; Schutz and Pekrun 2007). Past research on goals and emotions usually adopted the early dichotomous goal framework, used general, summary measures of emotion (positive versus negative affect), and generally indicated inconsistent findings. With the exception of test anxiety, few studies examined the effects of goals on specific achievement emotions (Pekrun et al. 2002; 2009). Achievement emotions are defined as specific, discrete emotions that are directly linked to competence-related activities or outcomes, such as academic learning, classroom instruction, and achievement (Pekrun 2006). More recently, studies that used more differentiated conceptualisations of goals (e.g. trichotomous framework) and specific academic emotions produced more consistent results (Linnenbrink and Pintrich 2002; Pekrun et al. 2006, 2009). Pekrun and his colleagues (Pekrun et al. 2006) believed that by attending to the approach–avoidance distinction of achievement goals and studying specific, discrete emotions, more consistent results can be found. This study attempts to answer this call by examining how the adoption of different goal profiles is related to achievement emotions.

Multiple goals

Studies suggest that students may hold more than one goal concurrently in classroom situations (Harackiewicz et al. 1998; Meece and Holt 1993; Pintrich 2000; Wolters 2004). There are two schools of thoughts regarding the adoption of multiple goals. Under the mastery goal perspective (Barron and Harackiewicz 2001), it is assumed that mastery goals are adaptive while performance goals are maladaptive. On the other hand, according to the multiple-goal perspective (Barron and Harackiewicz 2001), adoption of both mastery goals and performance goals is considered to be most adaptive. The latter is in line with the revision of the dichotomous framework, which proposes a more adaptive role for performance goal (Harackiewicz et al. 1998). Overall, research on multiple goals indicated mixed results (e.g. Bouffard et al. 1995; Pintrich 2000; Shih 2005).

Despite the interest in multiple goals, most studies tended to focus on individual differences between isolated goals rather than intra-individual differences on the various goals (e.g. Bouffard et al. 1995; Pintrich 2000; Shih 2005). In addition, few studies investigated all the four goal constructs of the 2×2 achievement goal framework.

One of the few exceptions is a study by Daniels et al. (2008), which used an intra-individual approach to examine goal profiles. In this study, cluster analysis was used to classify undergraduates in Canada according to their adoption of mastery approach and performance approach goals. Four clusters were found, namely, a group high on both mastery and performance approach (multiple goals), a group high on mastery approach (mastery), a group high on performance approach (performance), and a group low on both goals (low motivation). They found that while the multiple goals, performance, and mastery groups obtained similar academic achievements, the performance group displayed more negative cognitive appraisals (e.g. expected achievement, perceived success), as well as greater emotional vulnerability (e.g. enjoyment, boredom, anxiety). The low motivation cluster was found to be least adaptive. However, this study failed to include the avoidance aspects of achievement goals.

Another noteworthy exception is a recent study by Liu et al. (2009). Using cluster analysis to group Secondary Two students in Singapore, they found four clusters of student who differed in terms of their 2×2 achievement goals. The cluster that was high on all four achievement goals, and the cluster with high mastery approach, moderate for all other goals, were jointly found with most positive characteristics (e.g. behavioural regulation, autonomy support, perceived competence, enjoyment, value, and amotivation) and positive perceived outcomes (e.g. communication, collaboration, and problem-solving skills). In contrast, the cluster with low scores for all four achievement goals had the most maladaptive profile.

Similarly, a study conducted within the physical education context by Wang et al. (2007) used cluster analysis to group Singaporean youths according to their 2×2 achievement goals. Four clusters were found, with the cluster having high scores on all four achievement goals and the cluster having high scores on mastery approach and mastery avoidance goals both having the most adaptive set of psychological characteristics and outcomes, i.e. perceived competence, amotivation, effort, enjoyment of physical activities. The cluster having low scores on all four achievement goals was found to have the most maladaptive set of psychological characteristics and outcomes.

These studies highlighted the need for more studies to examine the effects of avoidance goals on various cognitive, behavioural, and affective outcomes in collectivistic societies, such as Singapore.

Current study differs from the two reported Singaporean studies due to the inclusion of achievement emotions. This study seeks to examine the following research questions:

1. Are there subgroups of students with significantly different goal profiles?
2. Do these subgroups of students differ significantly in terms of their learning strategies, achievement emotions, and mathematics performance?

Method

Participants and procedures

Five hundred and five Secondary Two students from two government coeducational secondary schools participated in this study. Data from 25 of the respondents were excluded from the analysis due to missing data or response set. That leaves a total of 480 participants, of which 248 were males. There were 189 participants from the first school and 282 from the other school.

Students are placed in the special, express, normal (academic) or normal (technical) stream according to their academic performance at the Primary School Leaving Examinations (PSLE). However, as approximately 8% (Ministry of Education 2007) of each cohort of primary school graduates are placed in the special stream, and most of these students attend autonomous or independent schools instead of government coeducational schools, the special stream was excluded from this study. Hence, the participants were from three other educational streams, reflecting different academic abilities; 296 were from the express stream, 146 from the normal (academic) stream, and 35 from the normal (technical) stream. Henceforth, they would be referred to as the higher-ability, average-ability, and lower-ability stream, respectively. Most of the participants were aged between 13 to 14 years, with few exceptions (seven of the participants were 15 years old and two were 17 years old).

Permission for the study was granted by the Ministry of Education, Singapore, and the principals of the schools. None of the students refused to take part in the study. Before the self-report questionnaire was administered, participants were informed that there were no right or wrong answers. They were assured that their responses were confidential and that only the researcher would have access to the data. They were also encouraged to seek clarifications if necessary. The participants took an average of 30 mins to complete the questionnaire. English is the medium of education in Singapore. It is the first language taught in schools, and the main language used at the workplace. The students' marks for a subsequent mathematics examination, taken about 3 months after the administration of the questionnaire, were obtained from the school.

Measures

Achievement goal questionnaire The student's achievement goals were measured using Elliot and McGregor's (2001) Achievement Goal Questionnaire (AGQ). The phrase 'this class' in the items were reworded to 'mathematics class' to refer to the mathematics context. The four subscales consisted of three items each. Example items include 'I want to learn as much as possible from mathematics class' (mastery approach), 'It is important for me to do better than other students' (performance approach), 'I worry that I may not learn all that I possibly could in mathematics class' (mastery avoidance), and 'I just want to avoid doing poorly in mathematics class' (performance avoidance).

Motivated strategies for learning questionnaire Items were adapted from the learning strategies section of the Motivated Strategies for Learning Questionnaire (MSLQ) to suit the mathematics context of secondary schools in Singapore. The scales of the MSLQ were designed to be modular and can be used singularly or in combination (Pintrich et al. 1991). Since we were only interested in students' use of cognitive and metacognitive strategies, the motivation section and the learning strategies section on student management of resources of the MSLQ were not included in this study. Specifically, the scales that were included were rehearsal, elaboration, organisation, critical thinking, and self-regulation. They provided a range of learning strategies, including surface processing, deep processing, and self-regulation (including meta-cognition). The first four scales were adapted from the MSLQ college version (Pintrich et al. 1991). The last scale was adapted from the MSLQ high school version (Pintrich and DeGroot 1990). An example from the rehearsal scale (four items) is 'When I study for mathematics class, I practice saying the material to myself over and over'. There were six items assessing elaboration, e.g. 'When studying for mathematics class, I try to relate the

material to what I already know', and four items measuring organisation, e.g. 'I make simple charts, diagrams, or tables to help me organise mathematics class material'. An example from the critical thinking scale (five items) is 'I often find myself questioning things I hear or read in mathematics class to decide if I find them convincing'. The nine items on the self-regulation scale measured both meta-cognition (i.e. planning, skimming, and comprehension monitoring) and effort management (i.e. persistence). An example is, 'I ask myself questions to make sure I know the mathematics class material I have been studying'.

Achievement emotions questionnaire The enjoyment, anxiety, and boredom scales were selected from the English version of the Achievement Emotion Questionnaire—Mathematics (AEQ-M; Pekrun et al. 2005). This instrument was specifically designed to assess student's achievement emotions experienced in relation to mathematics. There were ten items measuring enjoyment, e.g. 'I look forward to my mathematics class'; 15 items assessing anxiety, e.g. 'I am tense and nervous'; and six items for boredom, e.g. 'My mathematics homework bores me to death'.

For the above scales, participants responded on a seven-point Likert scale. The scale ranged from 1 (not at all true of me) to 7 (very true of me) for items on achievement goals and learning strategies, and 1 (strongly disagree) to 7 (strongly agree) for items on achievement emotions. Scale scores were constructed by taking the means of the relevant items. For items with negative wordings, the ratings were reversed before the scale scores were computed. Hence, higher scale scores indicated higher endorsement of an achievement goal, learning strategy, or emotion experienced.

All these questionnaires, AGQ, AEQ-M, and MSLQ are established questionnaires that have been validated and assessed to have adequate reliabilities (Elliot and McGregor 2001; Pekrun et al. 2005; Pintrich and DeGroot 1990; Pintrich et al. 1991). For this study, the alpha coefficients for the mastery approach, mastery avoidance, performance approach, and performance avoidance scales were 0.74, 0.73, 0.84, and 0.56, respectively. For the rehearsal, elaboration, organisation, critical thinking, and self-regulation scales, the alpha coefficients were found to be 0.74, 0.77, 0.72, 0.78, and 0.65, respectively. The alpha coefficients for the enjoyment, anxiety, and boredom scales were 0.90, 0.91, and 0.89, respectively.

Mathematics performance As a measure of the participants' mathematics knowledge and ability, their marks for their final-year mathematics examination were obtained. Students from different schools and different educational streams took different papers but the marks were all given on a 100-point scale.

Basic demographics such as gender, educational stream, and age were also obtained.

Results

A hierarchical cluster analysis was carried out using SPSS for Windows (Version 15) to identify distinct subgroups of participants with similar goal profiles. Before the analysis, the four goal orientations were converted to standardised z scores, with $M=0$, $SD=1$. Wards method was chosen as the clustering method as it minimises the within cluster differences and avoids problems such as the formation of long, snake-like chains, associated with other clustering methods (Aldenderfer and Blashfield 1984).

The dendrogram indicated the first large discrepancy in the rescaled distance when five clusters were combined into four clusters. This suggested that a five-cluster solution was most suitable for the data. It was noted that clusters 1 and 4 from the five-cluster solution were combined to form the four-cluster solution. MANOVA conducted on the five-cluster solution and the various outcome variables also indicated significant differences between clusters 1 and 4. This lent further support to the decision that a five-cluster solution was most appropriate.

Cluster profiles

The cluster size, means, standard deviations, and *z* scores of the clusters are presented in Table 1. Figure 1 shows the graphical representation of the five-cluster profile. *Z* scores of +/− 0.5 or greater were used as the criteria to describe whether a group scored relatively 'high' or 'low' in comparison to their peers.

The first cluster is made up of about 22% of the participants (59 males, 45 females) who endorsed all the four achievement goals highly. They are labelled the *high multiple goals* cluster. These students were interested in learning and understanding, wanted to avoid losing skills, desired to do better than others, and wanted to avoid being inferior to others.

The second group is labelled *high mastery approach, low mastery avoidance* cluster. They were characterised by high levels of mastery approach, low levels of mastery avoidance, and moderate levels of both performance approach and performance avoidance goals. These students were interested in learning and understanding, not worried about losing skills, and moderate in wanting to do better than others and avoiding being inferior. About 16% of the participants were in the second group, with 42 males and 33 females.

The third cluster consisted of about 22% of the participants (51 males, 51 females) who held low mastery and performance goals, in both the approach and avoidance dimensions. These students were not interested in learning or doing better than others, nor were they concerned about being inferior or losing skills. In other words, they had low motivation. This cluster is labelled the *low multiple goals* cluster.

The fourth cluster, labelled *high mastery avoidance* cluster, is made up of 27% of the participants (59 males, 72 females). Members of this group had high endorsements of mastery avoidance goal and moderate ratings on the rest of the three achievement goals. This group of students was fearful about losing skills. They were moderately interested in learning, performing better than others, and not appearing inferior.

The last cluster consists of about 14% of the participants (37 males, 31 females). They reported low performance goal (both approach and avoidance dimensions) endorsements and moderate mastery goal (both approach and avoidance dimensions) endorsements. These students were not concerned about performing better than others and not appearing inferior. They were moderately interested in learning and avoiding losing skills. This is labelled the *low performance goals* cluster.

Gender and stream effects on the clusters

To determine if there were significant gender and stream differences on the clusters, separate chi-square test of independence were conducted. Results revealed no significant gender difference. In contrast, significant stream differences were found, χ^2 (8, N=480)=16.55, p=0.04.

Examination of the distribution of students across the different streams and clusters suggested the following. Students from the higher-ability stream seemed to be over-represented in the *high multiple goals* and *high mastery approach, low mastery avoidance*

Table 1 Cluster means, standard deviations, and *Z* scores by the achievement goals

	Cluster 1 high multiple goals (n=104)			Cluster 2 high mastery approach (n=75)			Cluster 3 low multiple goals (n=102)			Cluster 4 high mastery avoidance (n=131)			Cluster 5 low performance goals (n=68)				
	M	SD	*Z*	*M*	SD	*Z*	*M*	SD	*Z*	*M*	SD	*Z*	*M*	SD	*Z*	*F* (4, 475)	η^2
Mastery Approach	6.41_a	0.49	0.64	6.40_a	0.53	0.63	4.22_c	0.80	−1.45	6.00_b	0.73	0.25	5.75_b	0.67	0.01	184.63*	0.61
Performance Approach	6.29_a	0.48	1.10	5.39_b	0.89	0.48	3.77_d	0.98	−0.63	4.71_c	0.98	0.01	2.78_e	1.00	−1.32	201.48*	0.63
Performance Avoidance	6.29_a	0.56	0.88	4.71_c	1.46	−0.34	4.37_c	1.11	−0.6	5.56_b	0.93	0.32	4.26_c	1.20	−0.68	64.83*	0.35
Mastery Avoidance	5.59_a	0.95	0.55	3.65_c	1.16	−0.91	3.91_c	0.90	−0.71	5.72_a	0.71	0.65	4.87_b	1.52	0.01	84.50*	0.42

Row means with different subscript differ significantly at $p<0.05$

*$p<0.001$

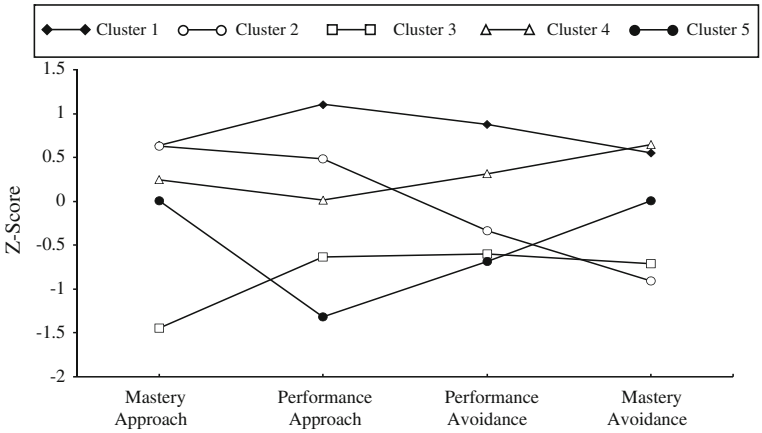

Fig. 1 Goal profiles of the five clusters

clusters (clusters 1 and 2, respectively), and under-represented in the *low multiple goals* and *high mastery avoidance* clusters (clusters 3 and 4, respectively). In stark contrast, students from the average-ability stream appeared to be under-represented in the *high multiple goals* and *high mastery approach, low mastery avoidance* clusters (clusters 1 and 2, respectively), while being over-represented in the *low multiple goals* and *high mastery avoidance* clusters (clusters 3 and 4, respectively). It is also interesting to note that there were proportionally less students from the lower-ability stream in the *high multiple goals* cluster (cluster 1), and proportionally more students in the *high mastery avoidance* and *low performance goals* clusters (clusters 4 and 5, respectively). Table 2 shows the distribution of the students according to cluster and stream.

Cluster differences in learning strategies

To examine whether the clusters differed according to their reported use of different learning strategies, MANOVA was conducted using cluster as the independent variable, and rehearsal, elaboration, organisation, critical thinking, and self-regulation, as the dependent variables. Results indicate that the five clusters differed significant in terms of the endorsement of learning strategies, Wilks' λ=0.75, F (20, 1563.08)=7.22, p<0.001, η^2= 0.07. Follow-up ANOVAs found that the five clusters differed significantly for all the learning strategies (all ps<0.001). To prevent the inflation of Type I error, Bonferroni

Table 2 Distribution of students according to cluster and educational stream

	Cluster 1 high multiple goals		Cluster 2 high mastery approach		Cluster 3 low multiple goals		Cluster 4 high mastery avoidance		Cluster 5 low performance goals	
Stream	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Higher-ability	71	23.99	55	18.58	51	17.23	75	25.34	44	14.86
Average-ability	28	18.79	14	9.40	44	29.53	45	30.20	18	12.08
Lower-ability	5	14.29	6	17.14	7	20.00	11	31.43	6	17.14
Overall	104	21.67	75	15.63	102	21.25	131	27.29	68	14.17

adjustments were made taking α_{crit} to be 0.01 (i.e. 0.05 divided by number of learning strategies). Post-hoc analyses using the Scheffe's method were then performed (see Table 3). Please refer to Fig. 2 for the graphical illustration of the learning strategies for the different clusters.

Overall, students from the *high multiple goals* cluster (cluster 1) generally indicated significantly higher levels of the various learning strategies. Only students from the *high mastery approach, low mastery avoidance* cluster (cluster 2) had a similar rating for self-regulation. Students from the *low multiple goals* cluster (cluster 3) generally endorsed significantly lower levels of the learning strategies than their peers. For critical thinking, organisation, and rehearsal, endorsements by students from the *low performance goals* cluster (cluster 5) were similar to those by students from the *low multiple goals* cluster (cluster 3). Otherwise, ratings by students from the *high mastery approach, low mastery avoidance*, *high mastery avoidance*, and *low performance goals* clusters (clusters 2, 4, and 5, respectively) were usually significantly lower than those by students from the *high multiple goals* cluster (cluster 1) and significantly higher than those by students from the *low multiple goals* cluster (cluster 3).

Cluster differences in achievement emotions

To examine cluster differences in terms of the reported achievement emotions, MANOVA was conducted using cluster as the independent variable and enjoyment, anxiety, and boredom, as the dependent variables. Results show that the five clusters were significantly different in their endorsement of achievement emotions, Wilks' $\lambda=0.78$, F (12, 1251.73)= 10.03, $p<0.001$, $\eta^2=0.08$. Follow-up ANOVAs found that the five clusters differed significantly for all the achievement emotions (all $ps<0.001$). To prevent the inflation of type I error, Bonferroni adjustments were made taking α_{crit} to be 0.016 (i.e. 0.05 divided by number of achievement emotions). Post-hoc analyses using the Scheffe's method were then performed (see Table 4). For the graphical representation of the achievement emotions for the different clusters, please see Fig. 3.

Students from the *high multiple goals* and *high mastery approach, low mastery avoidance* clusters (clusters 1 and 2, respectively) showed significantly higher levels of enjoyment than students from the other clusters. This was followed by students from the *high mastery avoidance* and *low performance goals* clusters (clusters 4 and 5, respectively), which were in turn significantly higher than those by students from the *low multiple goals* cluster (cluster 3). It is important to note that students from the *high mastery approach, low mastery avoidance* cluster (cluster 2) had significantly lower levels of anxiety and boredom than the students from the rest of the clusters. Students from the *high multiple goals* cluster (cluster 1) also had significantly lower levels of boredom than students from the *low multiple goals* cluster (cluster 3). Students from the rest of the clusters did not differ significantly in their level of anxiety and boredom.

Cluster differences in mathematics performance

ANOVA conducted indicates that the five clusters differed significantly in their mathematics performance, F (4, 475)=7.08, $p<0.001$, $\eta^2=0.06$. Post-hoc analyses using the Scheffe's method were then performed (see Table 4). For the graphical representation of the mathematics performance for the different clusters, please see Fig. 3.

Students from the *high mastery approach, low mastery avoidance* cluster (cluster 2) had the best mathematics results. Their results were significantly higher than the students from

Table 3 Cluster means, standard deviations, and *Z* scores by learning strategies

	Cluster 1 high multiple goals (n=104)			Cluster 2 high mastery approach (n=75)			Cluster 3 low multiple goals (n=102)			Cluster 4 high mastery avoidance (n=131)			Cluster 5 low performance goals (n=68)				
	M	SD	Z	M	SD	Z	M	SD	Z	M	SD	Z	M	SD	Z	F (4, 475)	η^2
Rehearsal	4.87_{a}	1.12	0.55	3.95_{bc}	1.34	−0.18	3.54_{c}	1.14	−0.50	4.35_{b}	1.12	0.13	4.00_{bc}	1.30	−0.14	17.96*	0.13
Elaboration	4.84_{a}	1.03	0.55	4.29_{b}	1.12	0.05	3.63_{c}	0.99	−0.54	4.24_{b}	1.02	0.00	4.12_{b}	1.09	−0.10	17.48*	0.13
Organisation	4.76_{a}	1.11	0.56	4.00_{b}	1.30	−0.06	3.53_{c}	1.19	−0.44	4.06_{b}	1.13	−0.01	3.93_{bc}	1.18	−0.12	14.72*	0.11
Critical thinking	4.74_{a}	1.13	0.56	4.13_{b}	1.27	0.04	3.51_{c}	1.06	−0.50	4.09_{b}	1.04	0.00	3.95_{bc}	0.95	−0.12	16.71*	0.12
Self-regulation	4.72_{ab}	0.75	0.35	4.84_{a}	0.81	0.48	3.90_{d}	0.76	−0.58	4.32_{c}	0.84	−0.10	4.41_{bc}	1.00	0.00	19.00*	0.14

Row means with different subscript differ significantly at $p<0.05$

*$p<0.001$

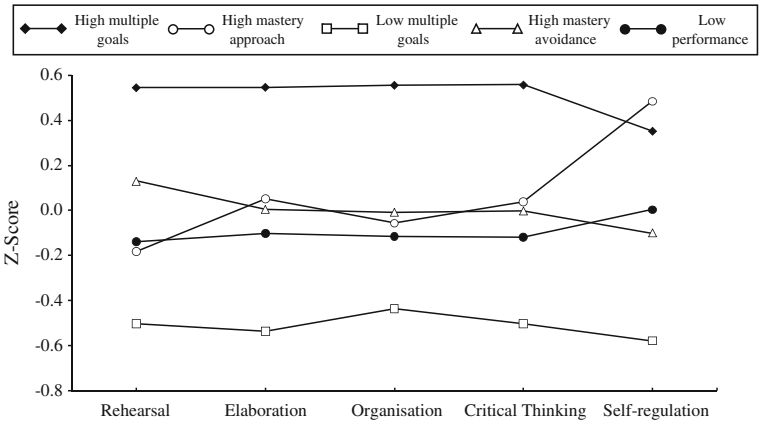

Fig. 2 Cluster profile in terms of learning strategies

the *low multiple goals* and *high mastery avoidance* clusters (clusters 3 and 4, respectively), albeit comparable to those of the students from the *high multiple goals* and *low performance goals* clusters (clusters 1 and 5, respectively).

Discussion

With reference to research question 1, cluster analysis revealed five clusters of students with significantly different goal profiles (see Fig. 1). The clusters were not related to the students' gender, but stream effect was noted. These clusters of students also differed significantly in terms of their use of learning strategies, experience of achievement emotions, and mathematics performance (see Figs. 2 and 3), answering research question 2.

Overall, the *high mastery approach, low mastery avoidance* cluster is noted to have the optimal profile as it was related to high mathematics performance, high enjoyment, but low anxiety and low boredom. This is followed by the *high multiple goals* cluster, which was related to high mathematics performance, high enjoyment, high anxiety, and moderate boredom. In comparison, the *low performance goals* and *high mastery avoidance* clusters had less-adaptive profiles. The *low multiple goals* cluster had the most maladaptive profile as it was related to low mathematics performance, low enjoyment, high anxiety, and high boredom.

It is of great concern that more than one in five of the participants (i.e. about 22%) made up the most maladaptive *low multiple goals* cluster where students held low levels of achievement goals, especially the mastery approach goal. In addition, the cluster appeared to be over-represented by students from the average-ability stream. Given the large proportion of students with this maladaptive set of goal profile, this sends a strong message to the policy makers and educators that it is paramount that active steps be taken to motivate the students, especially those within the average-ability stream.

It is noted that endorsement of high mastery approach goals is a common feature found in the clusters with the most optimal and second most adaptive profile of achievement-related variables. This suggests that educators should create an environment that promotes adoption of mastery approach goal. Ames (1992) and Epstein (1988) proposed the TARGET conceptual framework to help teachers create classroom environments that are

Table 4 Cluster means, standard deviations, and *Z* scores by achievement emotions and mathematics performance

	Cluster 1 high multiple goals (n=104)			Cluster 2 high mastery approach (n=75)			Cluster 3 low multiple goals (n=102)			Cluster 4 high mastery avoidance (n=131)			Cluster 5 low performance goals (n=68)				
	M	SD	Z	M	SD	Z	M	SD	Z	M	SD	Z	M	SD	Z	F (4, 475)	η^2
Enjoyment	4.93_{a}	1.29	0.45	5.02_{a}	1.02	0.52	3.65_{c}	1.15	−0.55	4.12_{b}	1.25	−0.18	4.24_{b}	1.12	−0.08	22.50*	0.16
Anxiety	3.42_{a}	1.26	0.05	2.54_{b}	1.00	−0.65	3.52_{a}	1.04	0.12	3.62_{a}	1.36	0.21	3.40_{a}	1.26	0.03	10.75*	0.08
Boredom	3.11_{b}	1.57	−0.10	2.37_{c}	1.10	−0.59	3.69_{a}	1.42	0.28	3.63_{ab}	1.61	0.24	3.18_{ab}	1.43	−0.06	11.53*	0.09
Mathematics performance	61.37_{ab}	18.77	0.03	69.57_{a}	15.04	0.48	55.27_{b}	18.98	−0.30	59.45_{b}	17.60	−0.07	60.68_{ab}	18.87	−0.00	7.08*	0.06

Row means with different subscript differ significantly at $p<0.05$

*$p<0.001$

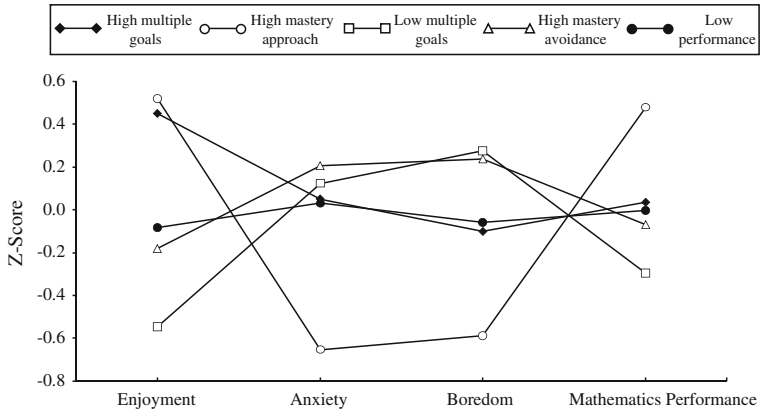

Fig. 3 Cluster profile in terms of achievement emotions and mathematics performance

focused on meaningful learning. TARGET is an acronym for task, authority, recognition, grouping, evaluation, and time. Task is related to the design of learning activities and assignments. To support mastery approach environment, tasks should be purposeful, challenging, and varied (Deemer 2004). Daniels et al. (2001) warned that when tasks are validated by threatening that task contents would be included in tests or that poor performance would result in negative consequences, students will equate learning solely with performing and importantly focus on negative consequences associated with not learning rather than focusing on positive reasons to learn. As such, teachers should provide explicit examples on how skills and knowledge learnt from mathematics tasks may be relevant and applicable out of the classroom context (Stipek 2002).

Authority refers to the opportunities to develop a sense of personal control and independence. Having students involved in decision making, assuming leadership roles, and taking responsibility during learning promotes a mastery approach environment (Deemer 2004). Students tend to be off-task because they are uncertain about how to meet task requirements or may be feeling that they are not up to the task. Instead of reprimanding them for being off-task, teachers should offer pointers such as scaffolding that helps students to be more aware of their capabilities and to be accountable for their own learning.

Recognition involves the formal and informal use of incentives and praise. Mastery approach environment is fostered when emphasis is on individual effort, progress, and improvement. Grouping refers to the arrangements within the classroom that allows for individual and cooperative learning, encouraging the mastery of course content. Evaluation alludes to the methods used to assess and monitor learning. Assessments and evaluations that focus on individual progress, improvement, and understanding promote a mastery approach environment. Time represents the pacing of instruction and workload. It was proposed that a mastery approach environment can be fostered by providing variety in the forms of instruction, as well as allowing students to work on tasks at their own pace (see Deemer (2004) for an in-depth discussion of the structure and application of the TARGET conceptual framework).

As positive experience of achievement emotions is valuable in their own right, the following are some suggestions on how teachers may promote them. Studies examining relationships between perceived classroom climate and students' achievement emotions found that perceived punishment from teacher and competition among classmates had

positive links with anxiety and boredom (e.g. Frenzel et al. 2007). In addition, perceived characteristics of teacher instructional strategies (e.g. quality of instruction, teacher enthusiasm), and achievement-contingent feedback (i.e. praise for success, support after failure) was found to be positively related to enjoyment and negatively related to boredom (e.g. Frenzel et al. 2007; Goetz et al. 2006). As suggested by Frenzel et al. (2007), teachers should place effort on improving clarity and level of structure of instruction, as well as keeping track of students' level of comprehension to foster a positive emotional atmosphere in the class. Furthermore, in attempts to mould student behaviour, teachers should consider providing incentives for desired learning- and class-related behaviours, rather than punishing undesirable behaviours or outcomes.

In a study by Daniels et al.(2008), their cluster of lowly motivated students (low mastery approach and performance approach) reported low enjoyment and high boredom, similar to the *low multiple goals* cluster in the current study. However, it is interesting to note that the two groups differed in their report of anxiety. Specifically, high anxiety is reported in the current study. It is uncertain if the difference in reported anxiety is due to the more differentiated conceptualisation of goals used in the current study or other factors.

Past studies (i.e. Liu et al. 2009; Wang et al. 2007) had difficulties differentiating between two clusters that appeared to have equally optimal profiles. Liu and colleagues (Liu et al. 2009) found that the cluster that was high on all four achievement goals, and the cluster with high mastery approach but moderate other goals, had equally positive characteristics and positive perceived outcomes. Wang and his colleagues (Wang et al. 2007) noted in their study that the cluster with high scores on all four achievement goals and the cluster with high scores on mastery approach and mastery avoidance goals had similar optimal sets of psychological characteristics and outcomes. A similar situation would be encountered during this investigation if achievement emotions, specifically, anxiety had not been included in this study. This underlines the importance of studying anxiety and highlights the need for more investigation of achievement emotions.

Results suggest that patterns of multiple goal pursuit are more complicated than the four patterns that Barron and Harackiewicz (2000, 2001) had proposed to explain how the mastery and performance goals might combine to facilitate performance. More importantly, findings provide initial information on how the patterns of multiple goal pursuit may be conceptualised given the addition of the approach–avoidance distinction. Evidently, more studies are required to better understand how the different achievement goals can be combined to influence achievement-related variables.

This study also demonstrates the utility of cluster analysis as an effective avenue to understand the patterns of multiple goal pursuit given that it allows for the examination of multiple goal adoption at an intrapersonal level.

In summary, the findings of the current study provide support for the 2×2 achievement goal framework and indicated that the four achievement goals are significantly related to the students' use of learning strategies, experience of achievement emotions, and mathematics performance.

Cluster analysis revealed that students do hold multiple goals and the high *mastery approach, low mastery avoidance* cluster was noted to have the most optimal profile. The usefulness of cluster analysis to gain a better understanding of the adoption of multiple goals and its impact on achievement-related variables is reinforced. Findings highlight that there is a large cluster of students who are lowly motivated and reinforced the need to provide a mastery approach environment for the students. Suggestions of means of promoting a mastery approach environment were provided. Findings also reinforce the utility and importance of studying achievement emotion.

Caution must be taken in generalising the results of this study. While the small sample size of lower-ability students is reflective of a proportionally smaller population of lower-ability students in the overall secondary school education system, it is possible that this small sample size of the students in the lower-ability stream may not be representative as it was a convenient sample. Similarly, the student population was sampled from two coeducational government secondary schools in Singapore. Hence, it is uncertain if results from this study could be extrapolated to schools with distinctly different climate such as single-sex schools, independent schools, or to other cultures. It has to be noted that the performance avoidance scale had relatively low reliability in this study. So, the results would have to be interpreted with caution.

As with all studies utilising a self-report method, it should be noted that self-reports might not be accurate representation of the actual situation / experience. Hence, results need to be interpreted with caution. Further studies using other research methodologies such as behavioural observations or interviews could be conducted to triangulate the findings.

It should also be noted that the relationships investigated in this study are correlational in nature. Hence, causal relations between the variables cannot be implied.

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