Achievement Goals, Implicit Theories and Behavioral Regulation among Polytechnic Engineering Students

C. K. John Wang
Woon Chia Liu
Stefanie Chye
Nanyang Technological University, Singapore

Abstract

This study examined the relationships between the approach-avoidance dimension, as well as the mastery-performance dimension of achievement goals, implicit theory of intelligence, and behavioral regulations among engineering students in a polytechnic in the academic domain. Polytechnic students (n = 1359) from Singapore participated in the survey. They were assessed on achievement goal orientations, implicit beliefs, behavioral regulations, values, effort and enjoyment towards their course of study using questionnaires. Cluster analysis was conducted and the results showed that five distinct clusters could differentiate the students in terms of their achievement goals profiles. Follow-up tests between the clusters showed that the five clusters had differing psychological characteristics, and differing values, effort, and enjoyment towards their course of study. Taken together, the present study offers some insights into intraindividual's differences in achievement goals and its impact and offers some useful implications for interventions.

Keywords: cluster analysis, motivation, implicit theories, self-determination theory, achievement goals

Introduction

One of the most critical influences on students' level of cognitive engagement in school work or their choice of cognitive strategies is their motivation to learn. For years, motivation has been a central topic in educational and psychological research. Researchers are interested to find out why and how some students strive and excel in schools, while others struggle and drop out of the academic world. To understand these complex behaviors in achievement setting, many researchers advocate the adoption of a theoretical stance to advance our understanding beyond descriptive data. However, with so many theories being proposed and debated, motivational research may appear to be diffused and fragmented. No one single theory has yet to claim the ability to explain motivated behavior in its entirety. Therefore, there is a need to use a combination of theories to understand complex human motivation (Roberts, 1992; Weiner, 1992). The purpose of this study was to examine the motivational profiles using a combination of achievement goal theory, implicit theories of intelligence, and self-determination theory at an intraindividual level (within person).

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Achievement Goal Theory

The achievement goal approach to achievement motivation has been tremendously helpful in acquiring an understanding of affect, cognition, and behavior in academic setting. This approach has not only been fruitful on the conceptual level, but has also produced clear guidelines for application and intervention. The traditional achievement goal theory was proposed by Nicholls (1989). This theory proposes that individuals' goal orientation and perceived ability contribute to affective outcomes in a given achievement setting. A key assumption of this approach is that the goal of action is the demonstration of competence. Therefore, the perception of ability becomes a central variable. Two major achievement goals interact with perceived competence in determining different cognitive, affective and behavioral outcomes. The first goal is mastery goal which focuses on self-referenced mastery or learning how to improve on the task. The second goal perspective is performance goal which emphasizes on normative comparison of ability or performance relative to others. It was hypothesized that mastery-oriented individuals, regardless of their levels of perceived competence, would tend to exhibit positive or adaptive motivated behavior. Similarly, performance-oriented individuals with high perceived competence should also have adaptive motivational patterns (Dweck, 1986; Nicholls, 1984, 1989). However, those with low perceived competence are likely to be motivationally fragile and would exhibit maladaptive motivational responses.

Recently, Elliot and his colleagues (Elliot, 1997; Elliot & Harackiewicz, 1996) have argued that a full account of achievement goals requires attention to the approach-avoidance distinction in addition to the traditional mastery-performance distinction. In the achievement domain, approach goals focus on attaining competence, whereas avoidance goals focus on avoiding showing incompetence. Elliot conducted a few laboratory experiments and found that it was possible to distinguish performance goals into approach and avoidance tendencies. He later found the same results for mastery goals. As a result, Elliot & McGregor (2001) proposed a 2 x 2 achievement goal framework that fully incorporates the mastery-performance and approach-avoidance distinctions. Crossing these two dimensions yields four achievement goals: mastery-approach (focused on task-based or intrapersonal competence, e.g. "I want to learn as much as possible from this class"), mastery-avoidance (focused on task-based or intrapersonal incompetence, e.g., "I am often concerned that I may not learn all that there is to learn in this class"), performance-approach (focused on normative competence, e.g., "It is important for me to do better than other students"), and performance-avoidance (focused on normative incompetence, e.g., "My goal in this class is to avoid performing poorly").

Recent studies using the 2 x 2 achievement goal framework provide some evidence that each achievement goal predicted a different pattern of achievement-relevant process and outcomes. In general, it was found that mastery-approach and performance-approach goals contribute to positive effects and consequences, while mastery-avoidance and performance-avoidance goals predict and produce less adaptive motivational patterns (Elliot & McGregor, 2001; McGregor & Elliot, 2002). In the physical education context, Wang and his colleagues (Wang, Biddle, & Elliot, 2007; Wang et al., 2008) found that a person may endorse multiple goal perspectives, therefore, looking at the independent effect of each goal may not reveal a complete picture of the person's achievement motivation. For example, Wang et al. (2007) found four clusters of students with homogenous characteristics based on their achievement goals. The first cluster was a "moderate achievement goals" profile with all four achievement goals close to a standard score of zero. The second cluster consisted of students with a "low achievement goals" profile, in which the achievement goal scores are consistently around Z = -1.00. The third cluster was a "high achievement goals" profile with scores of mastery-approach, performance-approach, and performance-avoidance goals above Z =1.00, and mastery-approach goal scores above Z = 0.50. Finally, a fourth cluster was labeled as "mastery achievement goals," as it consisted of students with high mastery-approach and mastery-avoidance goal scores, and moderate performance-approach and performance-avoidance goal scores.

Implicit Theory of Intelligence

In the academic domain, Dweck and her colleagues (Dweck, 1986, 1999; Dweck & Leggett, 1988) suggest that the development of different goal orientations in academic achievement may be due to the beliefs about the nature of intelligence. Two types of implicit theories of intelligence exist underpin the types of goals adopted. An entity belief – a belief that intelligence is fixed and uncontrollable trait may foster an ego or performance orientation because pursuing such a goal favors positive judgment of ability or prevents negative judgment of it (Dweck & Leggett, 1988). An incremental belief – a belief that intelligence is malleable and controllable quality fosters a task or mastery orientation because it provides the opportunity for learning and improvement. A few studies have provided supporting evidence for such proposals (see (Dweck, 1999; Spray, Wang, Biddle, Chatzisarantis, & Warburton, 2006). In terms of achievement behaviors, studies have showed that when challenged, those with entity beliefs showed detrimental performance, negative affects and cognitions. On the other hand, those with incremental beliefs tend to show more adaptive motivational patterns, such as persistence, positive affect and effective problem solving strategies (Dweck, 1986; Mueller & Dweck, 1998; Wang & Biddle, 2001). Mastery and

performance achievement goals have typically been conceptualized as "approach" motivation. With the recent addition of avoidance dimension to achievement goals, the relationships between implicit theories of intelligence with the new addition approach-avoidance dimension of achievement goals are still not clear. In the present study, we attempt to examine these relationships as the information could be useful in understand a range of negative processes and outcomes associated with the avoidance dimension.

Self-Determination Theory

In an attempt to understand motivated behavior, Deci and Ryan (1985; Ryan & Deci, 2000a, 2000b) propose that motivation should be viewed as a multidimensional construct, and not a simple dichotomous concept. They present a more differentiated view of motivation in the self-determination theory (SDT) to explain the perceived forces that regulate behavior in various settings. In general, there are three categories of motivation along a self-determination continuum. Intrinsic motivation represents the motivation when one is doing something for its own sake and not for external rewards. Extrinsic motivation involves doing something as a means to an end. A state of amotivation also exists as one of the regulatory processes in the self-determination continuum. It refers to the relative lack of motivation where an absence of contingency between actions and outcomes is perceived, and reasons for continual involvements cannot be found (Pelletier et al., 1995; Vallerand & Fortier, 1998). According to Deci and Ryan (1985), amotivation is labelled as the 'external boundary' of extrinsic motivation, and is somewhat similar to feelings of helplessness.

There are at least three main types of regulatory processes within extrinsic motivation: external regulation, introjected regulation, and identified regulation. External regulation is characterized by behavior that is controlled by external forces, such as rewards or punishments. Introjected regulation pertains to behavior controlled by internal pressure to act, such as avoidance of guilt and shame. Identified regulation involves acting out because the behavior is seen as personally important.

Research has shown motivational benefits of more self-determined behavioral regulations in the classroom (e.g., Liu, Wang, Tan, Ee, & Koh, 2009; Ryan & Connell, 1989), as well as in physical activity contexts with young people (e.g., Chatzisarantis, Biddle, & Meek, 1997; Goudas, Biddle, & Fox, 1994; Wang & Biddle, 2001). In Ryan and Connell's (1989) study, external and introjected regulations in school children were related to anxiety and maladaptive behavior when faced with failures. On the other hand, identified regulation and intrinsic regulation were positively related to enjoyment and effort. More self-determined regulations were found to be related to mastery-approach and incremental beliefs and more controlled regulations were associated with performance-approach and entity beliefs

(Biddle, Wang, Chatzisarantis, & Spray, 2003; Spray et al., 2006; Wang & Liu, 2007). Given the empirical links between achievement goals, implicit beliefs, and behavioral regulations, it is important to validate the multivariate relationships between these theories to further our understanding of human motivation, particularly with the inclusion of the approach-avoidance dimension of the achievement goal theory.

Purpose of Study

The main purpose of the present study is to examine the relationships between the 2 x 2 achievement goals, implicit theories of intelligence, behavioral regulations, and motivational outcomes among polytechnic engineering students using a cluster analytic approach. Cluster analysis is a multivariate approach which allows the identification of subgroups of sample with homogenous characteristics based on the contemporary indicators of motivation. It may provide insights to the extent in which these motivational constructs are interrelated in a person, therefore, offers a way for conceptual convergence. Specifically, three research questions were formulated:

1) Are there subgroups of polytechnic engineering students with distinct profiles based on achievement goals? What are the characteristics of each goal profile?
2) What are the relationships between the different profiles in terms of their implicit theories and behavioral regulation?
3) What are the related motivational outcomes in terms of effort, value, and enjoyment among students in the different goal profiles?

Method

Participants and Procedure

A total of 1359 polytechnic students in Singapore took part in the study. These students (n = 1197 males, n = 128 females, 34 missing) were attending a three year diploma course in engineering. They were aged between 18 to 28 years old (mean = 20.18, sd = 0.48). Participants were informed that there were no right or wrong answers, assured of the confidentiality of their responses, and encouraged to ask questions if necessary. Completion of questionnaires took about thirty minutes. Permission for the study was granted by the director of the school, and no students refused to take part.

Measures

2 X 2 Achievement Goal Questionnaires (AGQ). Elliot and McGregor's (2001) 12-item AGQ was used to measure achievement goals in the classroom context. This questionnaire comprises four subscales (mastery-approach, mastery-avoidance, performance-approach, and performance avoidance). Examples of items are as follows: 'I want to learn as much as possible from my course' (mastery-approach), 'I am often concerned that I may not learn all that there is to learn in this course' (mastery-avoidance), 'It is important for me to do better than other students in my course' (performance-approach), 'My goal in this course is to avoid performing poorly' (performance-avoidance). Participants responded on 5-point Likert-type scale ranging from 'not at all true for me' (1) to 'very true for me' (5). The internal consistency coefficients of the mastery-approach goal (α = .79), performance-approach goal (α = .88), mastery-avoidance goal (α = .79), and performance-avoidance goal (α = .73) were satisfactory.

Implicit theory of Intelligence. The implicit theories of intelligence scale from Dweck (1999) was used to measure entity and incremental theory of intelligence. Incremental beliefs were assessed through 4 items (e.g., 'No matter who you are, you can significantly change your intelligence level'). Entity beliefs were also measured through 4 items (e.g., 'you have a certain amount of intelligence, and you can't really do much to change it'). All responses were made on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The internal reliability coefficients for incremental beliefs (α = .88) and entity beliefs (α = .86) were satisfactory for the present sample.

Perceived Locus of Causality. The Perceived Locus of Causality (PLOC) scale developed by Ryan and Connell's (1989) was adapted to assess four types of regulation in academic setting. The stem for all items was 'I do my work in my course…'. Four items were used to assess both external regulation (e.g., '. . . because I'll get into trouble if I don't') and introjected regulation (e.g., '. . . because I'll feel bad about myself if I didn't'). Identification (e.g., '. . . because I want to improve in my course') and intrinsic regulation (e.g., '. . . because my course is fun') were measured using three items each. The alpha coefficients were .76 for external regulation, .64 for introjection, .73 for identification, and .79 for intrinsic motivation. An overall relative autonomy index (RAI) was calculated by weighting each subscale to indicate the level of autonomy in the following way: external regulation (-2) + introjection (-1) + identification (+1) + intrinsic regulation (+2). The final RAI measure serves as an indicator of a person's overall motivational regulation with positive scores representing more autonomous regulation and negative scores representing more controlled regulation.

Motivational outcome variables. Three subscales of the Intrinsic Motivation Inventory were selected to assess enjoyment, effort and value (McAuley, Duncan, & Tammen, 1989). There were seven items for enjoyment, e.g., 'I would describe my course as very interesting'), five items measures effort, e.g., 'I put a lot of effort into my course', and seven items for value, e.g., 'I believe doing this course could be beneficial to me'. A 5-point scale was used, similar to all the above measures. The internal consistency coefficient for enjoyment was .87, for effort was .77 and for value was .79.

Data Analysis

Cluster analysis was used to identify homogenous groupings of participants with distinct patterns of achievement goals. Following that, we examined the cluster profiles related to implicit theory of intelligence, and behavioral regulations. To further test the concurrent validity of the clusters, we examined the cluster differences in value, effort and enjoyment. One-way MANOVA and follow-up ANOVAs were conducted, followed by post-hoc tests using Tukey 's HSD.

Results

Descriptive Statistics

The means, standard deviations, internal consistency and Pearson product-moment correlations coefficients of the key variables of the overall sample are presented in Table 1. Overall, the participants held high mastery-approach and performance-avoidance goals. They had high incremental beliefs, and low entity beliefs. They also had positive RAI scores towards their course of study. The value, effort exerted and enjoyment for the course were relatively high among the participants. Mastery-approach goals had a positive relationship with performance-approach goal, both types of avoidance goals, incremental beliefs, RAI, value, effort and enjoyment. Performance-approach goal had a moderate and positive relationship with performance-avoidance goals, value, enjoyment, and effort. Mastery-avoidance goals were correlated with performance-avoidance and entity beliefs. Finally, performance-avoidance goals had a small association with incremental beliefs and value.

Table 1
Means, Standard Deviations, Alpha and Pearson Correlation Coefficients between Key Variables of the Overall Sample

	M	*SD*	α	1	2	3	4	5	6	7	8	9
1. MastApp	3.86	.80	.79									
2. PerfApp	3.18	1.06	.88	.36**								
3. MastAvo	3.33	.91	.79	.26**	.16**							
4. PerfAvo	3.71	.92	.73	.26**	.29**	.25**						
5. Increm	3.47	.88	.84	.34**	.14**	- .04	.14**					
6.Entity	2.45	.99	.86	- .06*	.10**	.30**	.10**	- .47**				
7. RAI	2.68	2.98	---	.41**	.06*	- .03	- .08**	.18**	- .18**			
8. Value	3.69	.79	.89	.53**	.26**	.10**	.15**	.23**	- .07*	.42**		
9. Enjoy	3.21	.81	.87	.45**	.25**	- .01	.05	.20**	- .10**	.58**	.58**	
10.Effort	3.54	.73	.77	.47**	.33**	.09**	.24**	.26**	- .11**	.30**	.42**	.43**

Note. ** $p < .01$, * $p < .05$ MastApp = mastery-approach, PerfApp = performance-approach, MastAvo = mastery-avoidance, PerfAvo = performance-avoidance

To examine whether there were main gender and year main effects on the main clustering variables, a two-way MANOVAs were conducted. The results of the MANOVA showed that there were no significant multivariate effects on gender, as well as age effect (Wilk's $\Lambda = .985$, $F(4, 673) = .76$, $p = .55$, $\eta^2 = .005$, for sex, and Wilk's $\Lambda = .979$, $F(12, 1780) = 1.20$, $p = .27$, $\eta^2 = .007$, for age). No interaction effects were found too. Therefore, further analyses were conducted with the combined sample.

Cluster Analysis

A hierarchical cluster analysis was conducted using SPSS for Windows (Version 18.0). The four achievement goals were used to classify students into homogenous groups. Before the analysis, all the main variables were converted to standardized Z scores ($m = 0$, $sd = 1$). This will prevent variables measured in larger units from contributing more towards the distance measured than the variables utilizing smaller units (Everitt, 1993). For example, RAI has a range of –12 to 12, compared to other measures with range from 1 to 5.

Ward's method was chosen as the clustering method as this method minimizes the within-cluster differences and to avoid problems with forming

long, snake-like chains found in other methods (Aldenderfer & Blashfield, 1984). The agglomeration schedule and dendrogram were used to identify the number of clusters. Table 2 shows the agglomeration schedule for the last seven stages and percentage changes in coefficient to the next level. The clustering coefficient shows the first large increase (10.9%) when five clusters merged to four clusters. This implies that two dissimilar clusters are joined (Hair, Anderson, Tatham, & Black, 1998). Therefore, a five-cluster solution was found suitable.

Table 2
Analysis of Agglomeration Coefficients for Hierarchical Cluster Analysis

No. of Clusters	Agglomeration coefficient	% change in coefficient to next level
7	2733.1	6.4
6	2907.3	6.1
5	3086.2	10.9
4	3422.6	10.5
3	3783.3	12.0
2	4237.3	27.1
1	5384.0	

The cluster size, means, standard deviations, and z-scores of the five clusters are shown in Table 3. Figure 1 shows the graphical representation of the five cluster profiles. Z scores of +/-0.5 or greater were used as criteria to describe whether a group scored relatively 'high' or 'low' in comparison to their peers.

Table 3
Cluster Means, Standard Deviations, and z Scores for the Five-Cluster Solution of the Cluster Analysis

	Cluster 1 High mastapp / moderate perf (N = 264)			Cluster 2 High mastapp / low perf (N = 122)			Cluster 3 Low mastapp / high perf (N = 357)			Cluster 4 High mast / high perf (N = 257)			Cluster 5 Low mast / low perf (N = 347)		
	M	SD	*Z*	M	SD	*Z*	M	SD	*Z*	M	SD	*Z*	M	SD	*Z*
1. MastApp	4.39	.49	.66	4.31	.51	.56	3.56	.55	- .38	4.61	.41	.94	3.06	.58	-1.00
2.PerfApp	3.45	.99	.25	2.69	1.28	- .47	3.60	.62	.40	3.69	1.04	.48	2.34	.79	- .79
3. MastAvo	2.56	.74	- .84	3.59	.73	.28	3.57	.66	.27	4.29	.54	1.06	2.84	.71	- .53
4.PerfAvo	3.91	.75	.22	2.48	.78	-1.33	4.08	.64	.40	4.32	.54	.67	3.15	.84	- .61

Note. mastApp = mastery-approach, perf = performance, mast = mastery

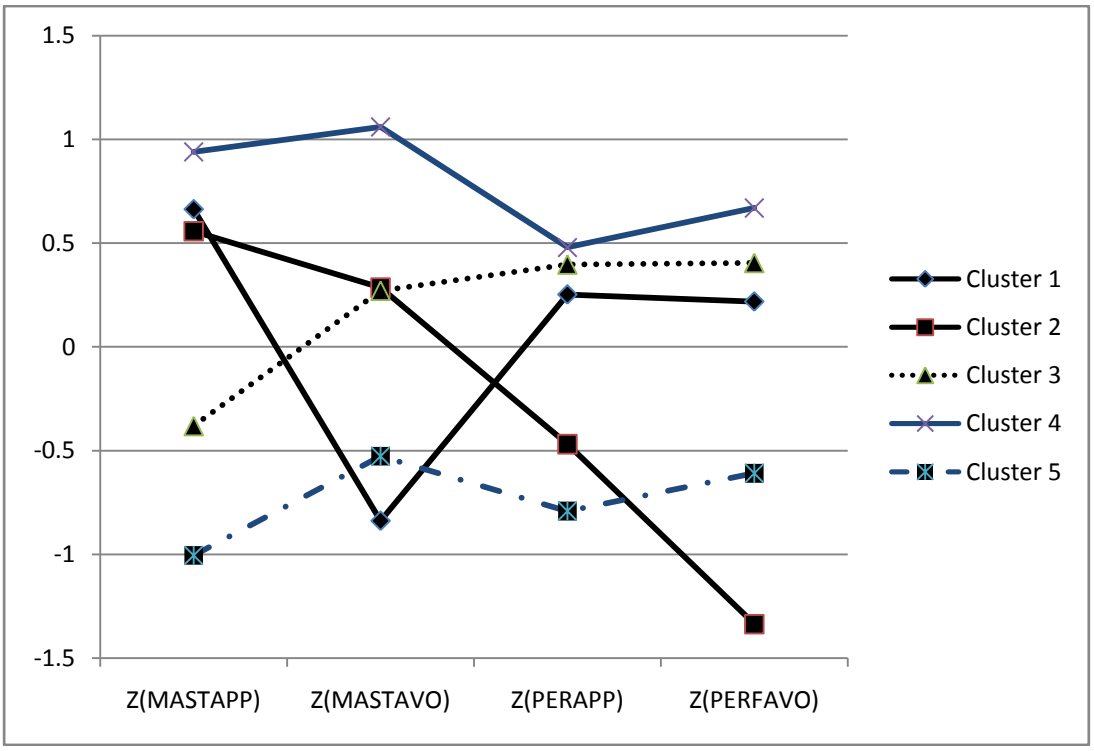

Figure 1. Goal profiles for the five-cluster solution of the cluster analysis

Profiles of the Achievement Goal Cluster

The first cluster can be labeled as the 'High Mastery-approach/moderate performance' group. There were 264 participants in this cluster (19.6%). The characteristics of this cluster were that they had high mastery-approach and very low mastery-avoidance goals, with moderate levels of performance goals (both approach and avoidance). The second cluster had high mastery-approach goals and moderate mastery-avoidance goals, and very low performance-approach and performance-avoidance goals. This cluster was labeled as 'high mastery-approach/low performance' group and consisted of 122 participants (9.1%). The third cluster had the highest proportion of the sample (26.5%, n = 357). This cluster had 'low mastery-approach/high performance'. Mastery-approach goal was relatively low among this cluster. The fourth cluster consists of 257 students (19.1%). The unique characteristics were distinctly high levels of performance and mastery goals, in both approach and avoidance dimensions. This cluster was labeled as 'high mastery/high performance'. The final cluster can be labeled as the 'low mastery/low performance' (Cluster 5). There were 347 participants in this cluster (25.8%). The characteristics of this cluster were that they had very low master and performance goals, in both approach and avoidance dimensions.

Cluster Differences in Implicit theories of Intelligence and Behavioral Regulation

In order to check the differences between the five clusters in terms of their implicit beliefs and behavioral regulations, a one-way MANOVA was conducted. The results showed that the five clusters differed significantly in incremental beliefs, entity beliefs, and RAI, Pillai's Trace = .231, $F(12, 4026) = 27.98$, $p < .001$, $\eta^2 = .08$. Test of between-subjects effects indicated significant differences existed for all three dependent variables (all *p*s < .001). The results are presented in Table 4 with the means and standard deviations of the dependent variables for the five clusters.

Post-hoc tests using Tukey's Honestly Significant Difference (HSD) were conducted to examine the pairwise comparison between the five clusters. Results showed that clusters 1, 2, and 4 had significant higher scores in their incremental beliefs compared to clusters 3 and 5 (all *ps* < .01). In terms of entity beliefs, clusters 3 and 4 had much higher scores than clusters 1, 2, and 5 (all *ps* < .01). No differences exist between clusters 2 and 5. It seems that incremental beliefs are aligned to mastery-approach goals, while no apparent patterns exist between entity beliefs and achievement goals. Clusters 3 and 5 had significantly lower scores in RAI, than clusters 1, 2 and 4 (all *ps* < .01) (see Table 4).

Table 4
Cluster Differences in Beliefs and Behavioral Regulation

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	$F_{(4, 1342)}$	η^2
Increm	3.82 (.78)^{a}	3.60 (.95)^{ab}	3.35 (.79)^{b}	3.67 (.99)^{a}	3.15 (.80)^{c}	29.51 **	.08
Entity	2.10 (.84)^{a}	2.24 (1.04)^{a}	2.72 (.96)^{b}	2.68 (1.18)^{b}	2.35 (.84)^{a}	21.84 **	.06
RAI	3.75 (2.90)^{a}	4.19 (2.93)^{a}	1.80 (2.88)^{b}	3.18 (2.92)^{a}	1.89 (2.63)^{b}	35.39 **	.10

*Note. ** p < .001, Increm = Incremental, means in the same row that do not share superscripts differ at p < .01 using Tukey's HSD*

Cluster Differences in Motivational Outcome Variables

A second one-way MANOVA was conducted to further test the concurrent validity of the five clusters. The results showed that the five clusters differed significantly in all the three dependent variables, Pillai's Trace = .243, $F(12, 4008) = 29.42$, $p < .001$, $\eta^2 = .08$. Follow-up ANOVAs showed that significant differences existed (all *p*s < .001). Table 5 presents

the means and standard deviations of the dependent variables for the five clusters.

Students from clusters 3 and 5 seem to value their course of study much lower than their counterparts in clusters 1, 2, and 4 (all *p*s < .01). However, cluster 5 had significant lower scores in value compared to cluster 3. Similarly, the students from these two clusters (3 and 5) reported significantly lower enjoyment and lower effort exertion. Again, students from cluster 5 reported much lower effort exertion compared to students from cluster 3 (see Table 5).

Table 5
Cluster Differences in Value, Effort and Intrinsic Motivation

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	$F(4, 1336)$	η^2
Value	3.98 (.70)^a	3.88 (.75)^a	3.54 (.70)^b	4.05 (.77)^a	3.27 (.73)^c	60.99**	.15
Enjoyment	3.53 (.78)^a	3.40 (.84)^a	3.02 (.74)^b	3.47 (.85)^a	2.90 (.66)^b	40.95**	.11
Effort	3.84 (.69)^a	3.76 (.71)^a	3.47 (.66)^b	3.84 (.73)^a	3.10 (.73)^c	68.72**	.17

*Note. ** p < .001, means in the same column that do not share superscripts differ at p < .01 using Tukey's HSD*

Discussion

The purpose of the present study was to examine the relationships between the 2 x 2 achievement goals, implicit theories, behavioral regulations and motivational outcomes among a group of polytechnic engineering students in Singapore using cluster analysis.

In terms of research question (1), the results of the present study showed that there were five groups of polytechnic engineering students with distinct achievement goal profiles. The five clusters were labeled as 'High Mastery-approach/moderate performance' (Cluster 1), 'high mastery-approach/low performance' (Cluster 2), 'low mastery-approach/high performance' (Cluster 3), 'high mastery/high performance' (Cluster 4) and 'low mastery/low performance' (Cluster 5). The results are consistent with a recent study by Liu and her colleagues (Liu et al., 2009) in terms of the 'high mastery-approach/low performance', 'high mastery/high performance' and 'low mastery/low performance' groups in the context of project work. Wang and his colleagues (Wang et al., 2007) also found similar profiles of 'high mastery/high performance' and 'low mastery/low performance'. However, the 'low mastery-approach/high performance' profile was not evident in previous

studies. In this study, the 'low mastery-approach/high performance' profile (Cluster 3) made up of 26.5% of the sample and this can be a worrying trend given the positive association of mastery-approach goal with more motivationally adaptive cognition, affect, and behavior as well as the negative consequences of high performance goals (Elliot & McGregor, 2001; McGregor & Elliot, 2002; Middleton & Midgley, 1997; Wang et al., 2007).

The second and third research questions examined the relationships between the different profiles in terms of their implicit beliefs and behavioral regulations and related outcomes. In essence, the clusters with high mastery-approach goals (Clusters 1, 2 and 4) had corresponding incremental beliefs. The students in these clusters also displayed relatively higher value of the course; they tended to enjoy the course more and exerted more effort in their study. On the contrary, the two clusters labeled as 'low mastery-approach/high performance' and 'low mastery/low performance' had the most maladaptive profile, as they has low incremental beliefs, low autonomy, low value, enjoyment and effort. The findings on the 'low mastery/low performance' are consistent with Liu et al. (2009) and Wang et al. (2007). However, the 'low mastery-approach/high performance' cluster (Cluster 3) is a new discovery. The psychological characteristic of this cluster had relative low incremental beliefs, high entity beliefs and very low feeling of autonomy. This cluster could be a reflection of the profile of a group of engineering students in the polytechnic. The reason may be these students did not have very good academic results from their General Cambridge Examination 'O' level and thus did not get the course of their choice. Dweck and her colleagues (Dweck, 1999; Dweck & Leggett, 1988) show that implicit theories determine goal adoption, the intervention for this group of students could be in cultivating an incremental belief and provide them with a more autonomy-supportive learning environment to enhance their autonomous regulation.

Previous studies (Liu et al., 2009; Wang et al., 2007) found gender differences among the clusters but this was not found in this study. The reason is because engineering courses are male dominated in Singapore. There were less than 10% of female in all the engineering courses. Earlier analysis of age effect was not found among the clusters; however, we observed that a higher percentage of the first year engineering students are in the more adaptive clusters. For example, there were 39% of first year students in the 'high mastery-approach/moderate performance' cluster and 40% of first year students in the 'high mastery/performance' cluster. As the students advance to their final year of study (Year 3), a higher proportion (37.2%) was found in the 'low mastery/low performance' and a lower proportion was found in the 'high mastery-approach/moderate performance (25%), 'high mastery-approach/low performance' (27%), although the age effect was not significant. It is possible that the students' beliefs and achievement goals be shaped by the environment as they progress through their course although this is not

tested in the current study. Future research should use a longitudinal approach to study the change in motivational profiles of the students.

The findings of the present study provide support that having high mastery-approach goals is the key to optimal motivation for learning. Students with high mastery-approach goals had relatively higher incremental beliefs, feeling of autonomy, value, exert more effort and enjoy learning. There are some practical suggestions using the TARGET principles, originally proposed by Epstein (1988) and Ames (1992) to increase the mastery goal structures in the classroom (Liu et al., 2009). TARGET is an acronym for Task, Authority, Recognition, Grouping, Evaluation and Time (see Deemer, 2004) for more details).

The present study advances the understanding of motivation in achievement settings in a few ways. First, this study examined the 2 x 2 achievement goals profiles of polytechnic engineering students and provided insight into the variations of achievement goals in determining different cognition, affection and behavior. Second, the findings show that different theoretical frameworks (achievement goals, implicit theories, and self-determination theory) can be examined concurrently to provide a more complete understanding of human motivation.

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About the Authors

Dr John Wang, C. K. (C. Psychol) is an Associate Professor and Deputy Head of the Physical Education and Sports Science Academic Group at the National Institute of Education, Singapore. He is the leader of the Motivation in Educational Research Laboratory (MERL) in National Institute of Education, Singapore. Email: john.wang@nie.edu.sg

Dr Liu Woon Chia is the Associate Dean for Practicum and School Partnerships (Office of Teacher Education) at the National Institute of Education, Singapore. She is also an Associate Professor with the Psychological Studies Academic Group and a founding member of the NIE's Motivation in Educational Research Laboratory. Email: woonchia.liu@nie.edu.sg

Dr Stephanie Chye is a lecturer with the Psychological Studies Academic Group and a core member of the Motivation in Educational Research Laboratory at the National Institute of Education, Singapore. Her area of expertise is in self-regulation learning instruction and problem-based learning. Email: stefanie.chye@nie.edu.sg