Predictive Value of Three Different Selection Methods for Admission of Motivated and Well-Performing Veterinary Medical Students

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ABSTRACT

In search for valid and reliable selection methods that predict applicants' study motivation and academic performance during the 3-year bachelor's program at the Dutch Faculty of Veterinary Medicine (FVM), this study aimed to (1) examine the predictive value of the three FVM selection methods for study motivation and academic performance (i.e., direct admission and weighted lottery based on secondary school grade point average [GPA], and selection based on non-cognitive criteria), and (2) examine whether *type* and *level* of study motivation could be of value regarding selection of well-performing students. Data from two cohorts at the FVM (n = 186) were obtained, including mean summed scores on study motivation (using the Academic Motivation Scale [AMS] and additional items) and several academic outcome measures; among others, analyses of covariance (ANCOVA) were performed to examine differences between the three admission groups. Spearman's correlations and linear regression were applied to examine the relationship between study motivation and academic performance. Lottery-admitted students demonstrated a stronger extrinsic motivation than selected students ($p < .05$). Directly admitted students outperformed students from the other two admission groups on several academic outcome measures ($p < .05$). Only the level of motivation was related to academic performance ($p < .05$). According to the results, direct admission based on a high secondary school GPA in particular has predictive value for good academic performance during the 3-year bachelor's program of the veterinary course. The type of motivation seems to be of no value regarding selection of well-performing students, whereas level of motivation might be a useful criterion for this purpose.

Key words: admission procedure, selection method, veterinary education, cognitive/non-cognitive selection criteria, admission criteria, Academic Motivation Scale, study motivation, academic performance

INTRODUCTION

In the Netherlands, admission of veterinary medical students is restricted due to an excess of suitable candidates and a restricted number of available places (i.e., *numerus fixus*). The Faculty of Veterinary Medicine (FVM)* of Utrecht University is allowed to select a maximum number of 225 students each year. The central aim of the FVM's selection procedure is to select motivated and well-performing students who are able to successfully complete the 3-year bachelor's program within 4 years. Up to the academic year 2016–2017, three selection methods have been applied for this purpose, including direct admission, weighted lottery, and selection based on non-cognitive criteria.

Extensive research has been conducted on selection of students. Previous cognitive performance, such as a high pre-university grade point average (GPA), appears to be adequate for selection of well-performing students,[1–6] especially in the first few academic years.[7,8] A relationship between undergraduate GPA and clinical performance after at least 12 months of post-graduate clinical training has also been demonstrated,[4] as well as a correlation between undergraduate GPA and subsequent cumulative GPA in veterinary school.[9] A correlation between pre-admission GPA and clinical performance during medical courses is less clear.[5]

With regard to selection methods based on non-cognitive selection criteria, there is no consensus in the literature on whether such methods result in admission of students that are more successful in their studies. Moruzi and Norman[4] showed that measures of several non-cognitive qualities, for example in an interview, do not explain a significant portion of variance on performance measures. Non-cognitive aspects such as personality measures on the other hand, seem to contribute to predicting good performance.[10] Furthermore, scores on verbal, quantitative, and analytical reasoning (as measured by the Graduate Record Examinations General Test) are found to be significantly related to first-year grades among veterinary medical students.[11]

Students admitted by a selection process including both cognitive and non-cognitive criteria are found to drop out less often during the course of the study.[12,13] Lucieer et al.[14] showed that the use of solely non-cognitive selection criteria is insufficient for selecting the best performing students. In line with these findings, one might say that a selection procedure based on a combination of cognitive- and non-cognitive criteria may be preferred, as also supported by several studies in the context of both medical and veterinary education.[7,8,15]

The aim of selecting motivated students is mainly based on a positive relationship between motivation and academic performance, and a positive effect of motivation on study-related activities.[16–22] Among veterinary medical students, motivation is a commonly mentioned factor to enhance their study progress.[23] Moreover, motivation for participating in extracurricular activities is found to be related to academic performance in the veterinary curriculum.[24] On the other hand, research has shown that both very successful and less successful veterinary medical students show 'drops' in motivation during their studies.[25] Little is known about a correlation between motivation and performance during the veterinary undergraduate course in particular.[26]

Strength of motivation for studying in general can be appointed as *level* of motivation. In addition to level of motivation, several *types* of motivation have been described in the literature.[18] The Self-Determination Theory[18] distinguishes, among others, intrinsic motivation (IM) and extrinsic motivation (EM). IM means that one is interested in a task, and enjoys performing it; achieving a goal gives a kind of satisfaction.[17] EM is based on the consequences that arise from a particular action. On one hand, people can identify themselves with the value of a task or have integrated this value into their sense of self. On the other hand, behavior can also be stimulated by a possible reward or punishment, avoidance of shame or ego involvements; in this case, one feels pressure to act, think, or feel in certain ways. The opposite of both types of motivation is amotivation (AM), which implies that one does not have any motivation or intention to reach a goal.[18]

Regarding education, one can say that IM derives from a student's real interest in the study itself. EM can exist in a controlled way, such as parents who want their son or daughter to complete a study; on the other hand, it can include a more autonomous form, in which a student is fully aware of the relevance of performing a certain assignment or task, or the value of completing a study.[17] With regard to academic performance, IM is an important concept in education, because it can provide high quality of performance.[17] Recent studies regarding the relationship between profiles of IM and EM and academic performance showed that students with primarily IM showed better academic performance than students with primarily EM.[27,28] However, some tasks require EM, since the level of IM for these tasks can be low (e.g., less interesting tasks).[17] It is not entirely clear which types of motivation are most desirable in the context of admission procedures.

Due to the numerus fixus for the veterinary course, there is a need for valid and reliable selection methods that predict applicants' study motivation and academic performance during the 3-year bachelor's-program. Extensive research on selection procedures and criteria has been conducted in both medical and veterinary education contexts.[15] However, the selection procedure as applied by the FVM, including a selection method based on some specific non-cognitive criteria, has not been investigated yet. With regard to selection of motivated students, it is unknown whether study motivation is related to performance during the veterinary undergraduate course in particular.[26] In addition, little research has been conducted on the stability of study motivation after admission. In line with these considerations, the first aim of this study is to examine the predictive value of the three different FVM selection methods (applying either a high secondary school GPA or non-cognitive criteria) for study motivation and academic performance during the 3-year bachelor's-program of the veterinary course. For this purpose, it is investigated which FVM selection method(s) has or have been most efficient regarding selection of students who are motivated and perform well during the bachelor's program. The second aim of this study is to examine whether type and level of study motivation could be of value regarding selection of students who perform well during the 3-year bachelor's program of the veterinary course. For this purpose, the relationship between study motivation and academic performance is investigated.

MATERIALS AND METHODS

Context

The FVM of Utrecht University is the one place to study veterinary medicine in the Netherlands. The FVM course consists of a 3-year theoretically oriented bachelor's program and a 3-year clinically oriented master's program and corresponds to 4 years of veterinary school in the United States. Table 1 shows a description of the FVM selection methods.

As most students choose for the tracks 'Companion Animal Medicine' and 'Equine Medicine' during the FVM Master's-program, selection based on non-cognitive criteria has been introduced to attract students who are motivated for a career in Farm Animal and Veterinary Public Health (FA/VPH). The procedure includes a pre-structured panel interview that is conducted by a Doctor of Veterinary Medicine (DVM) lecturer, a DVM practitioner, and a veterinary medical student who have received an intensive 2-day training in behavior-oriented interviewing. The STAR-technique is used to gather information about the applicants' capabilities—that is, Situation, Task, Action, Result. Applicants are assessed by an 'evaluation criteria set', using a score sheet. Pre-admission academic achievements (such as secondary school GPA) are not taken into account.[29] Candidates are allowed to participate in this selection procedure only once. Non-selected students can participate in a weighted lottery and can, when placed, choose for the track FA/VPH.

Participants

Two cohorts of veterinary medical students at the FVM of Utrecht University, consisting of cohort 2014–2015 (participating in the second year of the bachelor's program) and cohort 2013–2014 (participating in the third year of the bachelor's program), were invited to participate.

Table 1: Selection methods of the FVM

Selection method	Procedure	Number of students admitted
Direct admission	Admission based on a secondary school GPA of 8* or higher	All students who fit this category
Weighted lottery	Lottery based on secondary school GPA (students with the highest GPA have the greatest chance of being selected)	At least 50% of 225 students each academic year
Selection based on non-cognitive criteria	Structured panel interview based on motivation for a career in Farm Animal and Veterinary Public Health (FA/VPH) and non-cognitive selection criteria, including integrity, resoluteness/decisiveness, sociability, organizational consciousness, and general suitability[29]	Maximum of 70 students (30%) each academic year

FVM = Faculty of Veterinary Medicine; GPA = grade point average

*Rated on a scale ranging from 1 = *poor* to 10 = *excellent*

Procedure

In October 2015, students were approached by means of an introductory email, including information about the study and a link to an online questionnaire. This questionnaire was designed in SurveyMonkey, to measure study motivation. An introductory letter and a letter of informed consent were enclosed, respectively to explain the goal of the study and to ask participants to agree for informed consent regarding the use of information about admission procedure and academic performance. After 1 and 2 weeks, a reminder was sent. Four gift certificates of 25 Euros (about $28 US) were raffled among the participants. Non-responders were approached by email, and asked for their motives for not responding. To examine sampling bias regarding academic performance in particular, the overall mean grade of all courses so far of each cohort with responding students (derived from the Study Information and Registration System (OSIRIS) on June 8, 2016) was compared to the mean grade of the population (i.e., all second- or third-year students who were registered for the veterinary medicine [VM] course for academic year 2015–2016 in June 2016 [n = 433]).

Measures

The online questionnaire included questions on general data, including name, student number, gender, age, year of curriculum, and admission procedure by which the student had been selected.

To measure students' type of motivation for studying VM, a modified version of the Academic Motivation Scale (AMS)[30,31] was used. The AMS, which is a validated questionnaire[32,33] based on the Self-Determination Theory,[18] consists of 28 items which can be scored using a 7-point Likert scale (ranging from 1 = *does not correspond at all* to 7 = *corresponds exactly*).[30,31] The items are designed to answer the question of *why* a student is going to school or college, and result in a score on several types of motivation. Overall scores on IM, EM, and AM were included in the analyses, and calculated by summation of the scores on all items of the respective type of motivation. An example of an item indicating IM is "because I experience pleasure and satisfaction while learning new things." An example of an item indicating EM is "in order to obtain a more prestigious job later on." An example of an item indicating AM is "I don't know; I can't understand what I am doing in school." In line with the aim of this study, a few adjustments were made to the questionnaire. The main question was changed from "why do you go to college?" to "why are you studying VM?". Other adjustments, for example, concerned the change of "college education" to "veterinary education." The reliability coefficients (i.e., Cronbach's alpha) of IM, EM, and AM for cohort 2014–2015 were, respectively, α = .91, α = .84, and α = .58; the reliability coefficients of IM, EM, and AM for cohort 2013–2014 were, respectively, α = .90, α = .83, and α = .82. Considering a Cronbach's alpha of ≥ .70 as reliable, the reliability of the subscales IM and EM for both cohorts and the subscale AM for cohort 2013–2014 was confirmed.

To measure students' level of motivation for studying, five additional items were included in the questionnaire—that is, "I'm 100% committed to my study," "I invest much time in my study," and "my study is my top priority" (indicating motivation), and "I often invest too little effort in my study" and "I should spend more time on my study" (indicating amotivation). All items were scored using a 7-point Likert scale (ranging from 1 = *does not correspond at all* to 7 = *corresponds exactly*). The score for level of motivation was calculated by summation of the scores on the motivation items 1, 3 and 4, and the recoded scores on the amotivation items 2 and 5 (i.e., reverse scores: score 1 → score 7, score 2 → score 6, and so on). Reliability of the items of level of motivation was confirmed for both cohorts (α = .82 and α = .85).

Data on academic performance were collected from OSIRIS, including individual grades on all courses taken by the student so far. Electives were not taken into account, as the degree of difficulty differs among the various courses. Eight variables related to level of academic performance and academic progress (i.e., to what extent students complete their studies nominally) were derived from this data set of individual grades. Level of academic performance was measured by mean grade on all block courses taken by the

student so far (i.e., courses for the purpose of theoretical knowledge), mean grade on all longitudinal courses taken by the student so far (i.e., courses for the purpose of, for example, academic skills, clinical examination and clinical reasoning), mean grade on the course on professional development so far, and overall mean grade (i.e., mean grade of all course examinations so far). Only the first attempt was included, as this ensured that each student was able to prepare for the examination under the same circumstances and within the same timeframe. Academic progress was measured by the number of re-examinations needed so far and nominal achievement of European Credits (ECTS), i.e., points that can be obtained by completing a program course, forming a European standard for comparing study attainment and performance in higher education. Nominal achievement of ECTS included all ECTS in year 1, year 2, and both years of the curriculum (i.e., "60 ECTS obtained nominally in first year of curriculum," "52.5 ECTS obtained nominally in second year of curriculum," and "112.5 ECTS obtained in nominally in first and second years of curriculum"). "Nominally" was defined as obtaining the ECTS of the respective courses by means of a maximum of two attempts—that is, the second attempt in the same year as the first attempt. For further explanation on how data on academic progress were deduced from the individual grades and how all data in general were processed, please contact the primary author.

Statistical Analysis

Data analyses and statistics were performed using Excel and SPSS (version 23). All p values of ≤ .05 were considered statistically significant. If necessary, dependent variables were transformed to meet the conditions of a certain test (e.g., a square transformation). Inclusion of participants was based on maintaining a limit of 10% missing values: if more than 10% of individual data regarding the questionnaire on study motivation or grades in OSIRIS was missing, the respective respondent was excluded from the study. Missing values were excluded from the statistical analyses by means of pairwise deletion; for example, if a mean grade had to be calculated over 13 grades but only 12 grades were available, only these 12 grades were included in the calculation.

Descriptive statistics were used to describe the sample regarding age, gender, year of curriculum, and admission procedure; concerning these data, a Mann–Whitney U test and Chi-square tests were conducted to examine whether the sample was a good representation of the population (i.e., all second- and third-year students who were registered for the VM course [academic year 2015–2016] in December 2015, n = 422). A Mann–Whitney U test was applied to examine differences in overall mean grade between sample and population, for each cohort separately. A Kruskal–Wallis test was performed to compare mean age between the admission groups. By means of Chi-square tests and Fisher's exact tests, distribution of gender and year of curriculum were compared among these groups.

Examination of Predictive Value of Three Different FVM Selection Methods

First, differences in mean summed scores on study motivation, mean grades and number of re-examinations between the admission groups were examined by means of multivariable analyses of covariance (ANCOVA). Age (including three classes), gender, and admission procedure were included as independent variables. In this way, the analyses were controlled for the effect of age and gender, if statistically significant. Backward step-down selection was applied—that is, independent variables that did not demonstrate a statistically significant effect on the outcome variable (except for 'admission procedure') were excluded gradually from the model, in order from the highest p value. Exact (corrected) mean differences (*MD*) between the admission groups, if statistically significant, were determined by means of Bonferroni post hoc tests. Parameter estimates were analyzed as well. As three comparisons were made, p values of ≤ .017 were considered statistically significant. Variables that did not meet the conditions of the ANCOVA were analyzed by means of an univariable Kruskal–Wallis test. Statistically significant differences between the admission groups were specified by means of a Mann–Whitney U test. All p values ≤ .017 were considered statistically significant. These analyses could not be controlled for the effect of age and gender. An effect size (ES) of any statistically significant difference was calculated by means of Cohen's d. An ES > 0.80 was considered as a large effect.[34] Second, admission-group differences in number of students who had nominally achieved all ECTS in year 1, year 2, and both years of the curriculum were examined by means of univariable Chi-square tests and Fisher's exact tests. In addition, univariable and multivariable logistic regression analyses were performed; multivariable analyses included age (including three classes), gender, and admission procedure as independent variables, and were thereby controlled for the effect of age and gender. Backward step-down selection was applied; that is, independent variables that did not demonstrate a statistically significant effect on the outcome variable (except for *admission procedure*) were excluded gradually from the model, in order from the highest p value. In addition, if exclusion of a covariable (i.e., age or gender) resulted in a change of > 15% of one or more of the estimates of admission procedure, the covariable was included in the model (even if the p value was not statistically significant). All analyses were performed for both cohorts separately.

Examination of the Relationship Between Study Motivation and Academic Performance

The relationship between study motivation and academic performance was examined by means of Spearman's rank correlation coefficients regarding the variables of study motivation in relation to the variables of mean grades and number of re-examinations. In addition, multivariable linear regression analyses were performed, including IM, EM, AM, level of motivation, age and gender as independent variables, and each variable of mean grade as outcome variable. Backward step-down selection was applied; that is, independent variables that did not demonstrate a statistically significant effect on the outcome variable were excluded gradually from the model, in order from the highest p value. All analyses were performed separately for each cohort.

Ethical Approval

Ethical approval for this study was obtained from the Ethical Review Board of The Netherlands Association for Medical Education (in Dutch: Nederlandse Vereniging voor Medisch Onderwijs [NVMO]) at September 30, 2015 (dossier number: 584).

RESULTS

Participants

A total number of 406 students were approached, including 205 second-year students and 201 third-year students. Two hundred and fourteen students responded on the study motivation questionnaire and consented for the use of data on admission procedure and academic performance. Eighteen participants did not complete the questionnaire and were therefore excluded from the study. In addition, seven students were excluded because of too many missing grades, and three participants were excluded because they officially belonged to year 2 of the curriculum, but were studying for the third year. This resulted in a final study sample of 186 students and a response rate (RR) of 45.8%. The sample consisted of 91 second-year students (RR 44.4%) and 95 third-year students (RR 47.3%).

Mean age of the study sample was 20.92 years (± 2.20); all students were 18 years or older. Distribution of gender regarded 16.7% male (n = 31) and 83.3% female (n = 155). As no statistically significant differences were found between sample and study population (n = 422) concerning mean age, age distribution, gender distribution, and distribution of year of curriculum, the sample appeared to be a good representation of the study population.

Distribution of the three admission groups 'direct admission', 'weighted lottery' and 'selection based on non-cognitive criteria' among the sample was 11.8% (n = 22), 60.8% (n = 113), and 23.1% (n = 43), respectively. No statistically significant difference was found between this distribution and the population. Students who were rejected in selection and admitted by weighted lottery afterwards, comprising 4.3% (n = 8) of the sample, were excluded from the statistical analyses.

Most frequent reasons for not participating in the study were "I did not have the time to fill in the questionnaire" and "I forgot to fill in the questionnaire" (RR 19.0%). With regard to academic performance in particular, the sample of cohort 2013–2014 had a higher overall mean grade than the population—that is, 7.09 versus 6.64, respectively, on a scale ranging from 1 = *poor* to 10 = *excellent* (U = 4439.50, z = –7.69, p = .000). In cohort 2014–2015, no statistically significant difference was found between sample and population. These findings imply that with regard to the academic performance of cohort 2014–2015, the sample was a good representation of the study population; however, there might have been a certain sampling bias regarding the academic performance of cohort 2013–2014.

In cohort 2013–2014, statistically significant differences in both mean age (H_2 = 12.265, p = .002) and gender (χ^2 = 8.283, p = .014) were found between the three admission groups. Regarding the whole sample, no statistically significant difference in distribution of year of curriculum was found between the groups. These results imply that analyses of differences in study motivation and academic performance between the admission groups should be controlled for the effect of both age and gender, if statistically significant.

Examination of Predictive Value of Three Different FVM Selection Methods

Study motivation

Mean summed scores on IM, EM, AM and level of motivation among the admission groups of both cohorts are shown in Table 2.

In cohort 2013–2014, a statistically significant higher level of EM was shown among lottery-admitted students than among selected students; that is, students selected based on non-cognitive criteria (B = 6.67 (± 2.70), t = 2.47, p = .015, ES = 0.41). No statistically

Table 2: Mean (± *SD*) summed scores on motivational subscales among the admission groups of two cohorts

	Cohort	*n*	IM	EM	AM	Level of motivation
			(range 12–84)	(range 12–84)	(range 4–28)	(range 5–35)
Direct admission	2014–2015	11	56.09 (± 11.62)	47.09 (± 9.56)	4.09 (± 0.30)	29.82 (± 4.07)
	2013–2014	11	53.55 (± 14.08)	48.36 (± 10.05)	4.64 (± 0.92)	27.45 (± 5.50)
Weighted lottery	2014–2015	58	56.34 (± 12.24)	53.05 (± 12.46)	4.33 (± 0.91)	27.28 (± 5.50)
	2013–2014	55	58.25 (± 9.10)	53.25 (± 10.67)*	4.82 (± 2.33)	26.73 (± 6.23)
Selection based on non-cognitive criteria	2014–2015	18	58.78 (± 8.61)	54.06 (± 8.08)	4.56 (± 1.10)	25.39 (± 5.86)
	2013–2014	25	53.96 (± 13.76)	48.72 (± 11.82)*	5.28 (± 2.42)	25.48 (± 5.03)

IM = intrinsic motivation; EM = extrinsic motivation; AM = amotivation; ES = effect size

* Statistically significant difference (B = 6.67 [± 2.70], t = 2.47, p = .015, ES = 0.41), based on multivariable analyses of covariance (ANCOVA).

significant differences were found in IM, AM, or level of motivation between the admission groups in both cohorts.

Academic performance

Table 3 shows statistically significant differences in mean grades and number of re-examinations between the admission groups, after performing univariable and multivariable analyses.

Directly admitted students showed a statistically significant better performance than the other two admission groups on several academic outcome measures, including a large effect for each measure (i.e., ES > 0.80). Selected students did not outperform the other two admission groups on any of the academic outcome measures.

With regard to the variables '60 ECTS obtained nominally in first year of curriculum', 52.5 ECTS obtained nominally in second year of curriculum,' and '112.5 ECTS obtained nominally in first and second year of curriculum', descriptive statistics and results of Chi-square tests and Fisher's exact tests are shown in Table 4.

Fisher's exact test showed a statistically significant difference in 'number of students who had obtained 52.5 ECTS nominally in second year of curriculum' between the admission groups. Pairwise comparisons of admission groups showed that in the group of direct admission, more students had obtained 52.5 ECTS nominally in second year of curriculum (i.e., completing all courses nominally) than in the group of selection based on non-cognitive criteria ($\chi^2 = 7.92$, $p = .006$). The statistically significant difference in 'number of students who had obtained 112.5 ECTS nominally in first and second year of curriculum' was not confirmed after multivariable regression.

With regard to '60 ECTS obtained nominally in first year of curriculum' in cohort 2014–2015 and '52.5 ECTS obtained nominally in second year of curriculum' in cohort 2013–2014, univariable and multivariable logistic

Table 3: Results of univariable and multivariable analysis of differences in mean (± *SD*) grades and number of re-examinations between the admission groups

	Cohort 2014–2015			Cohort 2013–2014		
Academic performance	*n*	Group mean (± *SD*)	ES	*n*	Group mean (± *SD*)	ES
Mean grade on block courses*	87			91		
Direct admission	11	7.73 (± 0.77)		11	7.69 (± 0.67)	
Weighted lottery	58	6.79 (± 0.85)‡	1.12	55	6.55 (± 0.85)§	1.38
Selection based on non-cognitive criteria	18	6.55 (± 0.91)‡	1.37	25	6.45 (± 0.89)§	1.49
Mean grade on longitudinal courses*	87			91		
Direct admission	11	7.52 (± 0.58)		11	7.34 (± 0.61)	
Weighted lottery	58	7.12 (± 0.62)	0.65	55	6.84 (± 0.47)†	1.01
Selection based on non-cognitive criteria	18	7.13 (± 0.54)	0.70	25	6.86 (± 0.61)	0.79
Mean grade on professional development*	86			91		
Direct admission	11	8.27 (± 0.61)		11	8.11 (± 0.66)	
Weighted lottery	57	7.86 (± 0.85)	0.50	55	7.83 (± 0.61)	0.45
Selection based on non-cognitive criteria	18	7.71 (± 0.99)	0.65	25	7.71 (± 0.66)	0.61
Overall mean grade*	87			91		
Direct admission	11	7.74 (± 0.61)		11	7.68 (± 0.61)	
Weighted lottery	58	6.92 (± 0.73)‡	1.15	55	6.70 (± 0.73)§	1.38
Selection based on non-cognitive criteria	18	6.73 (± 0.79)‡	1.39	25	6.61 (± 0.78)§	1.46
Number of re-examinations	87			91		
Direct admission	11	0.55 (± 1.21)		11	0.00 (± 0.00)	
Weighted lottery	58	1.31 (± 1.77)	−0.45	55	4.05 (± 4.79)§	−0.92
Selection based on non-cognitive criteria	18	1.61 (± 1.61)	−0.72	25	4.28 (± 4.32)§	−1.18

ES = effect size

Note: All *p* values and ES relate to differences compared to the group of direct admission

*Rated on a scale ranging from 1 = *poor* to 10 = *excellent*

†$p \leq .05$

‡$p \leq .01$

§$p \leq .001$

Table 4: Descriptive statistics and results of Chi-square tests and Fisher's exact tests on nominal achievement of all ECTS in year 1, year 2, and both years of the curriculum

Academic performance	*n*	Number of students % (*n*)		$\chi 2$
		Yes	No	
Cohort 2014–2015				
60 ECTS obtained nominally in first year of curriculum	87			
Direct admission	11	100.0 (11)	0.0 (0)	
Weighted lottery	58	75.9 (44)	24.1 (14)	
Selection based on non-cognitive criteria	18	72.2 (13)	27.8 (5)	3.75
Cohort 2013–2014				
60 ECTS obtained nominally in first year of curriculum	91			
Direct admission	11	90.9 (10)	9.1 (1)	
Weighted lottery	55	58.2 (32)	41.8 (23)	
Selection based on non-cognitive criteria	25	48.0 (12)	52.0 (13)	5.91
52.5 ECTS obtained nominally in second year of curriculum	91			
Direct admission	11	100.0 (11)	0.0 (0)	
Weighted lottery	55	69.1 (38)	30.9 (17)	
Selection based on non-cognitive criteria	25	52.0 (13)	48.0 (12)	8.17*
112.5 ECTS obtained nominally in first and second year of curriculum	91			
Direct admission	11	90.9 (10)	9.1 (1)	
Weighted lottery	55	52.7 (29)	47.3 (26)	
Selection based on non-cognitive criteria	25	40.0 (10)	60.0 (15)	8.04*

ECTS = European Credits/European Credit Transfer System
* $p \leq .05$

regression analyses could not be applied on the pairwise comparisons including *direct admission* as one of the groups, as the comparisons included a group of zero students (i.e., OR = 0.000; $p = .999$ was found). As a result, these analyses could not be controlled for the effect of age and gender.

Examination of the Relationship Between Study Motivation and Academic Performance

Spearman's correlation-matrixes regarding the variables of study motivation, mean grades and number of re-examinations are shown in Table 5 (cohort 2014–2015) and Table 6 (cohort 2013–2014).

Statistically significant correlations between several study motivation variables in both cohorts were found, which emphasized the importance of conducting multivariable regression analyses (including all study motivation variables as independent variables) to examine the relationship between study motivation and academic performance. All variables of mean grades and number of re-examinations showed a statistically significant correlation with level of motivation in both cohorts. In addition, a statistically significant negative correlation was found between mean grade on Professional Development and AM in cohort 2013–2014. Multivariable linear regression analyses (to the extent that these could be applied) confirmed the correlations between level of motivation and all mean grades in both cohorts ($p < .01$). The negative correlation between mean grade on Professional Development and AM in cohort 2013–2014 however, was not confirmed.

DISCUSSION

In searching for valid and reliable selection methods that predict applicants' study motivation and academic performance during the 3-year bachelor's-program, the first aim of the study was to examine the predictive value of the three different FVM selection methods for study motivation and academic performance during the bachelor's program of the veterinary course.

With regard to study motivation, a difference between the admission groups concerned a stronger EM in lottery-admitted students compared to selected students (i.e., students selected based on non-cognitive criteria) in one of the cohorts. This finding is difficult to interpret, as lottery-admitted students are admitted 'randomly' without application of selection criteria, except for the fact that students with a higher secondary school GPA have a greater chance of being selected. Therefore, the stronger EM cannot be considered as the result of using a certain selection method or criterion. No other differences in study motivation were found between the admission groups. Selected students in particular did not have a higher score on IM, EM, or level of motivation than students from the

Table 5: Correlations between variables of study motivation and academic performance in cohort 2014–2015

	IM	EM	AM	LM	MGB	MGL	MGPD	MGO	NR
IM	1	–	–	–	–	–	–	–	–
EM	.436†	1	–	–	–	–	–	–	–
AM	–.112	.200	1	–	–	–	–	–	–
LM	.141	.009	–.127	1	–	–	–	–	–
MGB	–.004	.033	–.024	.511†	1	–	–	–	–
MGL	.160	.165	–.039	.228*	.536†	1	–	–	–
MGPD	–.064	.033	.015	.380†	.376†	.397†	1	–	–
MGO	.017	.060	–.018	.515†	.987†	.632†	.469†	1	–
NR	.072	–.071	–.014	–.510†	–.850†	–.407†	–.250*	–.823†	1

IM = intrinsic motivation; EM = extrinsic motivation; AM = amotivation; LM = level of motivation; MGB = mean grade on block courses; MGL = mean grade on longitudinal courses; MGPD = mean grade on professional development; MGO = overall mean grade; NR = number of re-examinations

* $p \leq .05$

† $p \leq .01$

Table 6: Correlations between variables of study motivation and academic performance in cohort 2013–2014

	IM	EM	AM	LM	MGB	MGL	MGPD	MGO	NR
IM	1	–	–	–	–	–	–	–	–
EM	.352†	1	–	–	–	–	–	–	–
AM	–.370†	.034	1	–	–	–	–	–	–
LM	.293†	–.097	–.411†	1	–	–	–	–	–
MGB	.019	–.056	–.155	.402†	1	–	–	–	–
MGL	.098	.043	–.139	.382†	.756†	1	–	–	–
MGPD	.182	–.008	–.205*	.395†	.269†	.290†	1	–	–
MGO	.046	–.041	–.163	.421†	.994†	.794†	.334†	1	–
NR	–.041	.026	.146	–.352†	–.925†	–.717†	–.292†	–.930†	1

IM = intrinsic motivation; EM = extrinsic motivation; AM = amotivation; LM = level of motivation; MGB = mean grade on block courses; MGL = mean grade on longitudinal courses; MGPD = mean grade on professional development; MGO = overall mean grade; NR = number of re-examinations

* $p \leq .05$

† $p \leq .01$

two other admission groups. These results imply that 'being selected' in itself, is not related to the strength or quality of study motivation, which is in contrast with previous research.[35] An explanation may be related to the long time elapsed between admission and the measurement of study motivation. Previous research showed that the enhancement of students' motivation because of the fact that 'they have been selected' might be only temporarily,[35] and in the meantime, their motivation may have been affected by other factors, i.e., the learning environment.[36,37] Research among veterinary medical students for example showed that students' motivation increases when studying subjects relevant to clinical practice and decreases in case of high workload, excessive detail and low relevance for clinical practice.[37] Type of motivation on the other hand is affected by satisfaction of the needs for competence, autonomy, and relatedness.[16,17] These findings suggest that any differences in type or level of motivation between the three admission groups may be difficult to measure in the second and third years of the curriculum; many other factors could have affected these measures in the years between admission and measurement. Therefore, for the purpose of examining the efficacy of selecting students who are strongly motivated during the entire course, the degree of stability of study motivation is an essential aspect.

With regard to academic performance, including measures of level of academic performance (i.e., mean grades) and academic progress (i.e., number of re-examinations and nominal achievement of all ECTS), selected students did not outperform lottery-admitted students in any of the measures of academic performance. Directly admitted students on the other hand, had a better score than lottery-admitted

students on multiple variables of academic performance in one or both cohorts; in addition, they outperformed selected students on several academic outcome measures. The only statistically significant difference in nominal achievement of all ECTS was found between directly admitted students and selected students, regarding '52.5 ECTS obtained nominally in second year of curriculum'. However, as this difference could not be corrected for the effect of age and gender, no conclusions can be drawn on this finding. Differentiation in mean grades on different types of courses (i.e., block courses, longitudinal courses, and professional development) did not reveal differences in competencies between the admission groups. The finding that students with a secondary school GPA of 8 or higher (i.e., directly admitted students) show the best academic performance during the course of the study is in line with previous research.[1–3,5–7] The absence of a statistically significant difference in academic performance between students selected based on non-cognitive criteria and lottery-admitted students corresponds with a previous study.[14]

According to the results, none of the FVM selection methods in particular has predictive value for high scores on study motivation during the bachelor's program. The finding that directly admitted students show better performance indicates that direct admission based on a secondary school GPA of 8 or higher has predictive value for good academic performance during the bachelor's program. As selected students did not outperform students admitted by the other two selection methods in any of the academic outcome measures, a selection method based solely on non-cognitive skills seems to have no predictive value for good academic performance. The results imply that selection based on previous cognitive performance (i.e., secondary school GPA) may be preferred above selection based on non-cognitive skills solely. No conclusions can be drawn on the use of a selection method based on a combination of cognitive- and non-cognitive criteria, as supported by previous studies.[7,8,15]

The second aim of the study was to examine whether type and level of study motivation could be of value regarding selection of students who perform well during the 3-year bachelor's program of the veterinary course.

None of the measures on IM, EM or AM showed a statistically significant correlation with academic performance. An explanation for this finding could be that the profile (i.e., ratio) of different types of motivation is more important for academic performance than the independent quantities of motivation.[27,28] In addition, research has shown that considering profiles of types of motivation is important for the stability of motivation during the course of the study.[27] In other words, these profiles could also serve another purpose, providing a reliable indication of study motivation in the future. The absence of correlations between the independent quantities of IM, EM, and AM and past academic performance implies that measuring type of motivation would not make a valuable contribution to an admission procedure, except for measuring the applicant's current type of motivation. In addition, a substantial risk of socially desirable answers could discourage the use in an admission setting. Nevertheless, this study considered measures of academic performance in the years of study before measuring motivation. The absence of a correlation between type of study motivation and past academic performance however, does not exclude a causal relationship between type of study motivation and future performance. Therefore, further research on the predictive validity of type of motivation for academic performance could contribute to a complete consideration on whether type of study motivation could be of value regarding selection of well-performing students in the veterinary course.

Level of motivation was positively correlated with several academic outcome measures. This correlation with past academic performance underlines the importance of level of motivation for study results, as mentioned by veterinary medical students.[23] It suggests that level of study motivation could be of value regarding selection of students who perform well during the bachelor's program of the veterinary course. However, in this case, the same critical notes regarding socially desirable answers are applicable as with regard to measuring type of motivation. Furthermore, as several factors such as high workload can affect level of motivation during the veterinary course,[37] the correlation with academic performance might be unstable as well. Therefore, further research should reveal whether level of motivation at the time of admission has predictive validity for academic performance during the course.

In conclusion, previous considerations imply that both type and level of study motivation could be of value regarding selection, both serving a different purpose. On the one hand, type of study motivation could give an indication of stability of motivation over time and hence motivation during the course; on the other hand, level of study motivation could provide an indication of academic performance. A critical note that should be mentioned is that this study has focused on motivation to study, which is different from motivation for the profession of being a veterinarian. For example, a student could be unmotivated for taking classes, while considering it as necessary for working in clinical practice in the future. The AMS only focuses minimally on study motivation originating from motivation for the profession later on.[30] As applicants with these motives could make successful students and veterinarians as well, it might be desirable to also consider motivation for the profession during selection.

Strengths and Limitations

This study has several strengths. A first strength is that a variety of outcomes is used to measure academic performance: mean grades (as an indication of level of academic performance), number of re-examinations, and nominal achievement of ECTS (as an indication of academic progress) were taken into account. In addition, a distinction was made in several types of courses, giving an indication of both cognitive (block and longitudinal courses) and non-cognitive (professional development) skills. A second strength is that second- and third-year students were included. In this way, data on study motivation and academic performance

Table 7: Glossary (definitions of abbreviations and frequently used terms in this study)

Term/Abbreviation	Definition
AM	Amotivation—implies that someone does not have any motivation or intention to reach a goal[18]
AMS	Academic Motivation Scale—questionnaire designed by Vallerand et al.[30] for the measurement of types of motivation
Block courses	FVM courses for the purpose of theoretical knowledge[39]
ECTS	European Credits/European Credit Transfer System—points that can be obtained by completing a program course (indicates a European standard for comparing study attainment and performance of students of higher education)
EM	Extrinsic motivation—implies that someone is focused on the consequences that arise from a particular action[17]
FVM	Faculty of Veterinary Medicine (Utrecht University)
FA/VPH	Farm Animal and Veterinary Public Health—one of the three tracks that are facilitated in the Master's program at the FVM, Utrecht University (the two other tracks focus on 'Companion Animal Medicine' and 'Equine Medicine')[40]
GPA	Grade point average—a number representing the average value of accumulated final grades earned in courses over time (e.g., the average of final grades of secondary school exams)[41]
IM	Intrinsic motivation—implies that someone is interested in a task, and enjoys performing it; achieving a goal gives a level of satisfaction[17]
Level of motivation	The strength of motivation for studying, without specifying what type of motivation it concerns
Longitudinal courses	FVM courses for the purpose of, for example, academic skills, clinical examination and clinical reasoning[39]
OSIRIS	Study Information and Registration System—used by various educational institutions, including Utrecht University

were obtained over a period of respectively 1.5 years and 2.5 years after admission. As a result, differences between the admission groups in motivation and performance were examined for two different periods.

There are also several limitations. A first limitation is the small sample size, which makes it difficult to draw reliable conclusions for a large population. In addition, due to the small sample size, multivariable analyses of each cohort could not be performed on all variables, as the conditions for these analyses were not satisfied, or the respective groups included too small numbers of students (which was the case in the logistic regression analyses). Therefore, not all analyses could be controlled for the effect of age and gender. A second limitation is that participation was on a voluntary base. Therefore, there might have been a certain sampling bias in participating students regarding their study motivation or academic performance. Due to the low response on the question regarding motives for not participating in the study (RR 19.0%), it is difficult to draw conclusions on sampling bias. Considering the statistically significant difference in academic performance between sample and population in cohort 2013–2014, there could be a certain sampling bias with regard to academic performance of this cohort. A third limitation is that the reliability of the AM subscale for cohort 2014–2015 was insufficient. Exclusion of items did not improve this reliability. Therefore, it is questionable whether results including AM of this cohort are reliable and how these results can be interpreted. A fourth limitation is that the use of backward step-down selection in regression analyses as applied in this study, involves several weaknesses as listed by Thompson.[38] This can lead to biases like over-fitting and incorrect significance tests. For future research one should consider to use alternative methods to stepwise regression. Finally, it may seem difficult to extrapolate some of the results of this study to other veterinary schools, using different methods of admission and grading systems. However, on a more general level, this study provides more insight on the relevance of a high secondary school GPA and non-cognitive criteria for admission of students for the bachelor's program of the FVM. Therefore, this study is relevant for all veterinary schools considering using cognitive or non-cognitive criteria in selection procedures.

CONCLUSION

According to the results in this study, none of the FVM selection methods in particular has predictive value for high scores on study motivation during the bachelor's-program of the veterinary course. Direct admission based on a high secondary school GPA in particular has predictive value for good academic performance during the course.

Type of study motivation seems to be of no value for selection of students who perform well during the bachelor's program, considering the absence of a correlation between types of motivation and academic performance. However, measuring type of motivation could serve a different purpose, as it could provide an indication of stability of motivation during the course. Level of motivation might be of value regarding selection, based on its positive relationship with academic performance. However, considering the method of measuring level of motivation, a risk of unreliable results in an admission setting due to socially desirable answers should be taken into account. Future research on predictive validity of type and level of motivation for academic performance is needed for a complete consideration on whether type and level of motivation could be of value for selection purposes.

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NOTE

* Definitions of abbreviations and frequently used terms in this study are shown in Table 7.

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