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Learning climate and feedback as predictors of dental students' self-determined motivation: The mediating role of basic psychological needs satisfaction.

Running Title: Basic psychological needs and students' motivation

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Disclosure

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ABSTRACT

Aim: The aim of this study was to test the mediating role of the satisfaction of dental students' basic psychological needs of autonomy, competence, and relatedness on the association between learning climate, feedback, and student motivation. The latter was based on the Self-Determination Theory's concepts of differentiation of autonomous motivation, controlled motivation, and amotivation.

Methods: A cross-sectional correlational study was conducted where 924 students completed self-reported questionnaires measuring motivation, perception of the learning climate, feedback, and basic psychological needs satisfaction. Descriptive statistics, Cronbach's alpha scores, and bivariate correlations were computed. Mediation of basic needs on each predictor-outcome association was tested based on a series of regression analyses. Finally, all variables were integrated into one structural equation model, controlling for the effects of age, gender, and year of study.

Results: Cronbach's alpha scores were acceptable (.655 to .905). Correlation analyses showed positive and significant associations between both an autonomy-supportive learning climate and the quantity and quality of feedback received, and students' autonomous motivation, which decreased and became negative when correlated with controlled motivation and amotivation, respectively. Regression analyses revealed that these associations were indirect and mediated by how these predictors satisfied students' basic psychological needs. These results were corroborated by the structural equation analysis, in which data fit the model well and regression paths were in the expected direction.

Conclusion: An autonomy-supportive learning climate and the quantity and quality of feedback were positive predictors of students' autonomous motivation and negative predictors of amotivation. However, this was an indirect association mediated by the satisfaction of students' basic psychological needs. Consequently, supporting students' needs of autonomy, competence and relatedness might lead to optimal types of motivation, which has an important influence on dental education.

KEYWORDS

Academic motivation, basic psychological needs, Chile, dental students, feedback, learning climate, Self-Determination Theory.

Introduction

Motivation is an increasingly important area of research on the education of health professionals; it can play a vital role in students' learning experiences and well-being.¹ The Self-Determination Theory (SDT) of motivation postulates that there are different types of motivation differing in their quality and that their particular influence on educational outcomes is more relevant than those of a quantifiable single-construct.² These types of motivation are categorised in a continuum from the least to the most self-determined types as amotivation, controlled motivation, and autonomous motivation.

As shown in Figure 1, there is amotivation on one end, which represents a non-regulated state defined by the absence of intent or drive to pursue an activity. Next, there is controlled motivation, which represents an intention to act and is formed by external and introjected regulation. This behaviour, however, is initiated due to pressures and demands towards specific outcomes that come from forces perceived to be external to the self. Finally, autonomous motivation, which is formed by identified and intrinsic regulation, represents students' intention to act based on a sense of full volition, choice, and self-determination. For a comprehensive review of Self-Determination Theory as applied to the education of health professionals, we refer the reader to the work of Ten Cate et al.¹

Data from several studies suggest that autonomous motivation has been associated with positive educational outcomes, such as reflection, self-concept, adaptation to university, positive emotions, engagement, academic performance, and support of the patients' autonomy.³⁻⁶ These associations become weaker and the

pattern is reversed when students experience controlled motivation and amotivation. Therefore, being motivated will not necessarily lead to positive educational outcomes; it is more important to be motivated in an autonomous fashion.

However, SDT postulates that these different types of motivation are a result of the interaction between students and social factors from the environment that can either support or hinder them.^{1,7} Factors such as early patient contact, year of curriculum, qualitative method of selection, positive and constructive feedback and an autonomy-supportive learning climate have been associated with students' autonomous motivation.^{3,4,8-10} The latter two factors have been referred to as important predictors of students' autonomous motivation,⁹⁻¹² but their influence has not been tested in dental education.

The learning climate, from the SDT perspective, can be one where teachers are either autonomy-supportive or controlling. Previous research has postulated that students' perception of an autonomy-supportive climate might facilitate the adoption of a deep learning approach and the integration of the material being taught.^{10,11,13} The central feature of autonomy support is that it allows students to choose between different options, minimises the pressure to perform and encourages their initiative.¹

Feedback can be defined as a way in which learners become aware of the gap between their current level of knowledge or skill and the desired goal.¹⁴ SDT establishes that the nature of feedback influences motivation and self-determination towards an activity. If feedback is economic, autonomous motivation will diminish; however, if the reinforcement is timely, formative and constructive, autonomous motivation towards an activity will increase.^{9,15}

These determinants have an important role on students' motivation; however, their influence has been found to be indirect and mediated by how they satisfy or prevent students' psychological needs of autonomy, competence and relatedness.¹⁶ The facilitation of these needs supports and maintains autonomous motivation, leading to positive developmental and psychological outcomes. As such, SDT has defined and grouped them as basic psychological needs.¹⁶ In contrast, social factors that prevent these basic needs will result in students experiencing controlled motivation or amotivation, leading to negative outcomes.¹ Therefore, students' perception that social factors such as learning climate and feedback satisfy these needs and not their planned objective is what mainly affects motivation.

The need for autonomy refers to making decisions by one's own will, based on one's own needs and values. Thus, students feel autonomous when they freely choose to devote time and energy to their studies or to a particular academic activity.¹⁷ The need for competence refers to feeling capable of performing a determined task, and it is related to seeking challenges that are optimal to one's abilities.¹⁸ The need for relatedness means being accepted and valued; it is a feeling of belongingness or connectedness with others as well as with a significant community, e.g., teachers, fellow students, or patients.¹⁶

Despite the importance placed by dental educators on the satisfaction of students' basic psychological needs,¹⁹ a recent systematic review revealed that no study so far had tested the mediating role of these needs between different social factors and dental students' motivation and that little attention has been paid to which variables influence students' motivation.²⁰ Therefore, the purpose of this study was to

test the mediating role of basic psychological needs on the relation between learning climate and feedback and dental students' motivation. The model presented in Figure 2 represents the hypothesis. Specifically, the study aimed to analyse the associations between the studied variables and to test the following hypotheses:

1. Basic psychological needs have a mediating effect on the relation between the learning climate and students' motivation and on the relation between feedback and students' motivation.
2. When integrated in a model, the learning climate and quantity and quality of feedback positively predict students' autonomous motivation over controlled motivation and negatively predict students' amotivation. This occurs through the mediation effect of basic psychological needs when controlling for the effects of age, gender, and year of study.

The present study fills a gap in the literature providing important insights about the process of motivation in dental students, which may lead to evidence-based interventions to foster students' optimal functioning.

Methods

The study was conducted at one dental school in Santiago, Chile, which has a six-year discipline-based undergraduate curriculum that mixes lectures and active, student-centred teaching strategies. The dental school's Research Ethics Committee reviewed and approved the study protocol (Reference Number: 2015-03-08/03).

The authors had access to the total student population; therefore, no sampling strategy was used. All students from years 1 to 6 were invited to answer four self-administered paper-based questionnaires at the end of one large group activity, in which they were informed that we were interested in better understanding the reasons why they attend university and how specific determinants influence those motives. Participation in the study was voluntary, with the option to withdraw at any time with no consequences or explanations required, and confidentiality and anonymity were guaranteed. Written informed consent was obtained before any data were collected and after students were presented with an information sheet with full detailed information on the study.

A large number of participants were anticipated, but in case of attrition and missing data, a sample calculation was conducted to ensure representativeness, which resulted in a sample size of at least 523 students (<http://www.surveysystem.com/sscalc.htm>). Additionally, an ad hoc power analysis for multiple regression was calculated using the G*Power software version 3.1.9.2 (Heinrich-Heine-Universität Düsseldorf, Germany)²¹ to allow the identification of small effects on the relationships between the studied variables, resulting in a minimum sample size of 550 students.

Variables and Instruments Used

Data were collected on demographics (age, gender and year of study) and academic motivation, as well as students' perceptions on the learning climate, the feedback they have received, and their satisfaction of their basic psychological needs.

Motivation was measured using the Spanish version of the Academic Motivation Scale, which was validated with a Chilean dental student sample.³ This instrument measures amotivation, controlled motivation and autonomous motivation on a seven-point Likert scale of 28 items.²² A high score on a subscale indicated high endorsement of that particular motivation type.

Autonomous motivation, controlled motivation, relative autonomous motivation (RAM) and amotivation were considered in our analyses. Autonomous motivation and controlled motivation were calculated by summing the average scores of their different regulation types. RAM, which is an index that provides a general score of students' levels of self-determination by estimating the degree of autonomous motivation over controlled motivation,⁴ was calculated by combining, assigning weights and adding intrinsic regulation (+2), identified regulation (+1), introjected regulation (-1) and external regulation (-2). A positive RAM suggested an autonomous or self-determined profile, whereas a negative RAM indicated a controlled or a non-self-determined profile.⁷ The amotivation score was taken directly from the correspondent subscale. Previous research has reported reliable scores for amotivation, controlled motivation and autonomous motivation (Cronbach's alpha 0.83, 0.74 and 0.75, respectively) and the successful use of RAM to combine the measures of controlled motivation and autonomous motivation.^{4,8}

Students' perceptions of the learning climate (autonomy-supportive or controlling) were measured using the Spanish version of the short Learning Climate Questionnaire.²³ It is a 5-item instrument with a single-factor structure presented in a seven-point Likert scale. The total score was calculated by averaging the individual item scores, where higher results represent students' perceiving the learning climate as autonomy supportive.

Students' perceived feedback was measured using the subscale of quantity and quality of feedback from the Spanish version of the Assessment Experience Questionnaire (AEQ).²⁴ Presented in a five-point Likert scale, the subscale of quantity and quality of feedback is composed of three negatively worded items, in which a higher average score (after reverse coding) represents a better feedback experience.

Basic psychological needs were measured using the Spanish version of the Basic Psychological Needs Satisfaction Scale.²⁵ It is a 15-item instrument divided into 3 subscales (autonomy, competence and relatedness) and presented as a five-point Likert scale. Scores of different items were averaged on the relevant subscale, and a higher score represented a higher degree of satisfaction of a particular need.

Data Analysis

The data analyses were conducted using the PASW (v 20.00; SPSS® Inc., Chicago, IL) and AMOS® software (v 20.0; SPSS Inc.), setting the alpha level at ≤ 0.05 . After screening for missing values and unengaged responses and checking for the assumptions of the general linear model, data were analysed with the following steps.

First, descriptive statistics and Cronbach's alpha measures were calculated. Second, bivariate correlations (Pearson's coefficient) were computed. Third, mediation was tested based on two regression models for each predictor, i.e., learning climate and feedback (Figure 2).²⁶ Both regression models tested how each predictor influenced RAM; however, the first model did not include the mediator variable, whereas the second did include the mediator variable.

Four conditions had to be met to assume a mediation effect: (1) a significant prediction of the outcome variable in the first regression model; (2) a significant prediction of the mediator in the second regression model; (3) the mediator had to significantly predict the outcome variable in the second regression model; and (4) the direct effect, i.e., the predictor variable directly predicting the outcome variable, had to be less strong in the second regression model than in the first.²⁷ Additionally, the indirect effect, i.e., the combined effect of the paths between predictor-mediator and mediator-outcome, was assessed based on its significance using the Sobel test²⁸ and based on its bootstrapped confidence interval.²⁹

Finally, all variables were integrated in one structural equation model (SEM) to test the overall relations, controlling for the effects of age, gender and year of study (Figure 3). These controls were added because previous research has reported their confounding effect on motivation variables.²⁰ SEM builds on statistical techniques such as correlation, multiple regression and ANOVA, and combines the strength of confirmatory factor analysis (CFA) to assess model fit with the multi-regression techniques of path analysis to explicate the relationships between variables.³⁰

Additionally, SEM has been referred to as a statistical method that has potential for advances in the education of health professionals.³¹

The model was estimated through the maximum likelihood method. Because there is no 'gold standard' that automatically and objectively leads to the decision on whether to reject or retain a model, the goodness-of-fit of the model to the data was calculated through a series of fit statistics.³² These included (with standard for acceptance in parenthesis) the chi-square test (χ^2 , > 0.05), the ratio of chi-square to degrees of freedom (χ^2/df , < 3), the Goodness of Fit Index (GFI, > 0.90), the Comparative Fit Index (CFI, > 0.90) and the root mean square error of approximation (RMSEA, < 0.08). Paths of the relationships between variables were estimated and interpreted as coefficients in multiple regression.

Results

Participants

A total of 924 students completed and returned the questionnaires (90.2% response rate), with an average age of 22.8 (SD= 3.36) and a gender distribution of 583 (63%) women and 341 (37%) men, which broadly corresponded to the distribution of the dental student population.

Reliability and descriptive statistics

As shown in Table 1, Cronbach's alpha values ranged from .655 to .905, which are in line with previous studies on the education of health professionals.^{3,4} Feedback displayed the lowest score at .655 but was still considered acceptable. Because this construct is composed of three items and measures both the quantity and quality of feedback, its lower score might be explained by the fact that internal consistency decreases when there are fewer items as well as when the scale attempts to measure more than one construct.³² Taken together, these results provide support that the measures used were reliable instruments within the context of this study.

The means and standard deviations presented in Table 1 show that in terms of their reasons to attend university, students endorsed autonomous motivation with the highest scores, followed by controlled motivation, with amotivation being the least endorsed. The positive RAM score suggests an overall self-determined profile amongst the whole sample population. Students' perceptions of the learning climate and

feedback received were both satisfactory, as the scores were above the mean point of each scale. Concerning the satisfaction of their basic psychological needs, the feeling of competence appears to be the most satisfied, followed by relatedness and autonomy.

Correlations

The results of the correlation analyses are presented in Table 1. Amotivation showed significant negative correlations with all other motivation variables. This was an anticipated result, as autonomous and controlled motivation represents intention to act (despite coming from internal or external sources), whereas amotivation refers to the lack of intention to act. However, autonomous motivation showed a significant positive correlation with controlled motivation (as they both represent intention to act) and with RAM. These results also show support for the RAM score, as it shows positive correlations with autonomous motivation and negative associations with controlled motivation and amotivation.

In terms of the associations between predictor variables, i.e., learning climate and feedback, and motivation, the former showed both significant positive correlations with autonomous motivation and weaker positive and negative associations with controlled motivation and amotivation. Therefore, an autonomy-supportive learning climate and a higher quantity and quality feedback experience showed a positive and significant association with students' autonomous motivation, which decreased and became negative when correlated with controlled motivation and amotivation. These

results are consistent with the correlations found between the satisfaction of the three basic psychological needs and motivational variables.

Mediation

As can be seen in Figure 3, simple regression tests showed a significant positive influence of both predictor variables over motivation, implying that an autonomy-supportive learning climate and higher quantity and quality of feedback positively predicted students' RAM.

In the second set of regression analyses, when the mediating variable was integrated, positive and significant relationships resulted between both predictor variables and the satisfaction of the basic psychological needs as well as between the mediator and students' RAM. This means that the autonomy supportiveness of the learning climate and the quantity and quality of feedback predicted students' perceptions of the satisfaction of their basic psychological needs, which was associated with an increment in students' RAM.

It is interesting to note that both direct effects from predictor to outcome variable became less strong when the mediator was included. Indeed, the direct effect in the mediating relationship between learning climate and RAM resulted in being non-significant, while the relationship between feedback and RAM became less strong and less significant. Moreover, the indirect effect of both predictors was significant, with regression coefficients within the confidence interval scores.

Overall, these results meet the criteria to assess mediation^{26,27} and indicate that an autonomy-supportive learning climate and the quantity and quality of feedback predicted dental students' RAM. However, this relationship was not direct; it was mediated by how students' perceive these predictors to satisfy their basic psychological needs of feeling autonomous, competent and related to important others.

Structural equation modelling

A first step to test the model as a whole was to assess its fitness to the observed data. Fit statistics showed that the chi-square test was significant ($\chi^2 = 53291$, $df = 19$, $p < 0.001$), suggesting a poor fit. Nevertheless, this test is sensitive to large samples and thus slight model-data discrepancies can be large enough to trigger a significant result.³² Therefore, approximate fit indices, less sensitive to sample sizes, were additionally calculated. $df/\chi^2 = 2.81$, $GFI = 0.989$, $CFI = 0.980$, and $RMSEA = 0.44$ (CI, 0.30, 0.58) were all above the standard for acceptance, suggesting an adequate fit, and thus the model was retained for parameter estimates.

The second step was to calculate the regression paths for the model. Figure 4 shows the structural model and the standardised regression coefficients between variables, which were over and above the effects of age, gender and year of curriculum. These show that all relationships were significant and in the hypothesised direction.

Learning climate and feedback were found to be positive predictors of the satisfaction of students' basic psychological needs. This means that students' perception of an autonomy-supportive learning climate and a higher quantity and quality

of feedback experience were associated with the satisfaction of their basic psychological needs. This influence, however, was stronger for the learning climate than for quantity and quality of feedback.

The basic psychological needs showed a positive and negative influence over RAM and amotivation, respectively. This implies that students' perception that their needs were being satisfied was positively correlated with them acting mostly out of autonomous motivation (vs. controlled) and negatively correlated with an amotivation experience. Moreover, the three indicators of the basic needs showed high standardised factor loadings ($>.50$), which adds additional convergent validity to the model³².

Discussion

The present investigation was designed in the context of dental education, where little is known about motivation from the SDT perspective.²⁰ As such, our study adds to the dental education literature by testing the influence of learning climate and feedback as well as the mediating effect of basic psychological needs satisfaction on students' motivation.

Both predictors tested in this study, i.e., learning climate and feedback, which previous literature has suggested as influential factors over students' autonomous motivation,²⁰ were found to positively influence dental students' autonomous motivation and to negatively predict amotivation, which was true when controlling for the effects of age, gender, and year of study. This effect, however, was mediated by how these predictors were perceived by students as satisfying their basic psychological needs. Indeed, in correlational analyses, both predictors were positively associated with the three basic psychological needs, which in turn showed decreasingly positive and negative correlations with controlled motivation and amotivation, respectively. This supports the claims of previous authors who argued that students must perceive these needs as satisfied to act out of and maintain their autonomous motivation.³³

These results were corroborated when analysing the associations integrated in the SEM. Interestingly, an autonomy-supportive learning climate was found to be a stronger predictor of students' motivation than the feedback received. This can be explained by the fact that feedback is nested in the quality of the environment and that it may be difficult to separate one variable from the other. Moreover, this seems to be consistent with other research that has applied similar methods, which found that an

autonomy-supportive learning climate was one of the most important ways in which students' needs might be satisfied, thus leading to autonomous motivation.³⁴

From these data, we can infer that dental students' autonomous motivation was not a direct effect of the autonomy-supportive (vs. controlling) learning climate and the quantity and quality of feedback received but rather was an effect of the influence these predictors had on students' perceptions of feeling autonomous, competent and related to important others, which in turn positively influenced their self-determined motivation. These results are consistent with data obtained in medical education, where an autonomy-supportive learning climate was found to encourage students' autonomous motivation.^{10,11}

In dentistry, while faculty have referred to autonomy-support and constructive feedback as means to encourage students' motivation, these associations are still understudied.¹⁹ Additionally, to the extent of our knowledge, this is the first study testing the mediating effect of basic psychological needs on motivation in dental education, which has been successfully studied in other fields of education.^{33,35} Our study therefore adds to the literature in both aspects.

These findings have a number of practical implications for dental educational practice and policy, as successes and failures in many elements of dental and health education can be understood from the SDT perspective. As such, efforts should be made in various aspects of dental education to support learners' senses of autonomy, competence and relatedness. It is therefore critical to consider how the learning climate and feedback received can be presented in such way that provides support for students' basic psychological needs. This may well mean a move towards more interactive

methods that promote students' needs. It also suggests that faculty should be trained to support these needs and become more autonomy-supportive and less controlling.

On the one hand, the learning climate should provide an initial welcoming and warm atmosphere, continuous interest in students, development of collegiality by encouraging team work, continuous transfer of clinical responsibility and respect for students as members of the dental team. It should also aim to foster leadership skills and encourage students to become reflective practitioners. Faculty should support students in exploring new methods and in being self-initiators rather than put pressure on them to behave. The learning climate should also include providing choice, volition and agency, so that students are involved in the decision-making process of their education. Meaningful rationale for activities should be provided so that students can internalise the reasons to engage in academic activities. The final aim should be to create a learning climate that fosters the conditions for students to become self-motivated rather than trying to control their behaviour.^{19,36,37}

On the other hand, feedback, which is an external input, should be given in a way that supports students' needs so it is accepted and internalised and serves as a nutrient for students' autonomous motivation. In this sense, feedback should be constructive, positive and timely, where teachers provide it as soon as the student finishes the clinical procedure, with an emphasis on the 'good things' and on what could be improved. It should be established as a dialogue and as a co-participative instance where reflection in- and on- action and self-assessment are encouraged. If feedback recipients feel free to draw their own conclusions, adapted behaviour is more likely to be felt as a choice and not as following directions from a preceptor. Feedback should be continuously

offered to students, and faculty should encourage feedback-seeking behaviour from trainees so they can ask for it whenever they feel they need it. Teachers should be bear in mind that receiving feedback is not easy, so the dialogue established should be based on empathy and assertiveness.^{9,19}

In this investigation we have focused on the predictive value of the learning climate and the quantity and quality of feedback; however, there is abundant room for future research to test other variables that may favourably influence dental students' needs and autonomous motivation. This might lead to the implementation of evidence-based strategies to support students, which would likely lead to enhanced educational outcomes.

For instance, curricular changes that allow students to choose how they learn (or provide options), recognise their levels of competence, and develop a sense of belongingness may increase identification and integration of the contents being taught. They may also encourage students to remember these contents and apply them in their future practice. Such changes could be related to competency- and entrustable professional activity-based education, core and options-based curriculum, small-group teaching, early patient contact, and horizontal and vertical integration amongst others. All of these could be understood through the SDT lens, as they increase feelings of autonomy, competence and relatedness compared to a traditionally structured and rigid curricula that might be unintentionally encouraging students' controlled motivation.^{1,38,39}

A limitation of this study is that it was conducted in one dental school in Chile, and while it was possible to generalise the results to the specific context of this dental school, we could not generalise our findings to either the Chilean dental education

system or to other dental education contexts. Nevertheless, we have presented this context. We have applied and described robust methods so that other authors can judge the transferability of our findings and perhaps replicate our study in different dental education contexts. Moreover, the positive and incremental single-centred investigations conducted on SDT in the education of health professionals have the potential to contribute to the enhancement of the theory's external validity, adding to its continuous non-refutation, which supports its generalisability.⁴⁰

There is also a limitation concerning how the data were collected. All instruments involved self-reported measures, which can introduce response bias due to lack of corroboration from other sources that could lead to desirable answers and can introduce inflated scores.⁴⁰ Recent research on motivation, however, has shown that students' perceptions of their social agents (instead of actual behaviour) are roughly equivalent to objective contextual variables and therefore would pose minor threats to the validity of our results, considering that the study did not involve any sensitive issues.⁴¹ Additionally, despite our research being designed as a cross-sectional correlational study involving the use of SEM, which is a highly conservative statistical technique, future research would benefit from moving towards longitudinal and experimental designs that might provide more definitive evidence on the mechanisms of student motivation and its maintenance.

Conclusion

This study found that an autonomy-supportive learning climate and the quantity and quality of feedback received were positive predictors of dental students' autonomous motivation (vs. controlled motivation) and negative predictors of amotivation. This, however, was an indirect association mediated by the satisfaction of students' basic psychological needs. Consequently, if the learning climate and feedback are planned and delivered in such way that they satisfy students' needs of autonomy, competence and relatedness, it might influence students to predominantly act out of the optimal types of motivation, which has an important influence on dental education.

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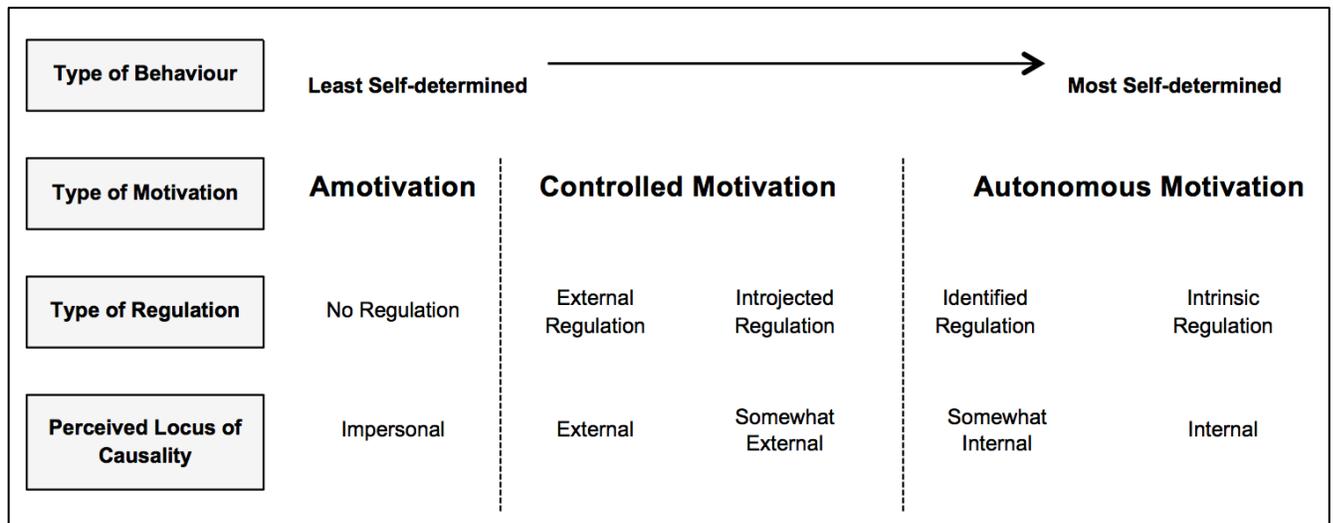


FIGURE 1 The Self-determination continuum, depicting types of behaviour, motivation, regulation, and locus of causality. (Adapted from Deci and Ryan, 2000)¹⁶

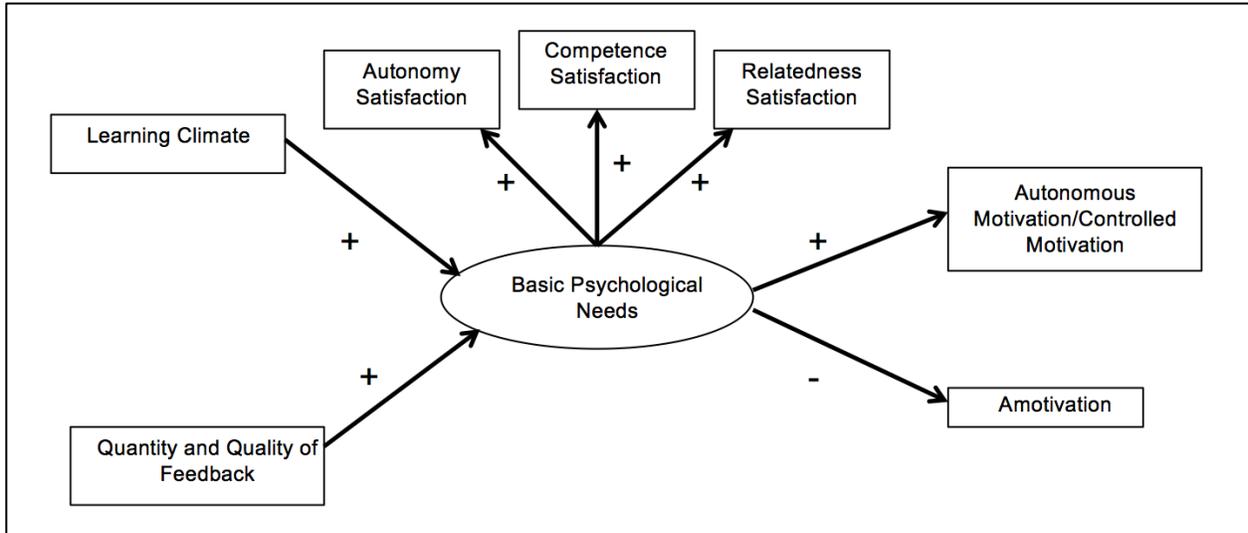


FIGURE 2 Hypothesised model for the mediating effect of Basic psychological needs on the relation between the learning climate and quantity and quality of feedback on dental students' motivation. The Basic Psychological Needs represents a latent variable composed by autonomy, competence and relatedness satisfaction.

TABLE 1 Bivariate correlations, internal consistency, and means (standard deviations) of all measures.

	Amot	AM	CM	RAM	LC	QQF	AS	RS	CS
Amot	-	-.44**	-.10**	-.24**	-.15**	-.23**	-.12**	-.25**	-.32**
AM		-	.49**	.29**	.32**	.08*	.26**	.32**	.40**
CM			-	-.66**	.16**	-.05	.17**	.19**	.15**
RAM				-	.11**	.12**	.07*	.09**	.19**
LC					-	.32**	.45**	.35**	.38**
QQF						-	.16**	.14**	.20**
AS							-	.44**	.41**
RS								-	.56**
CS									-
Alpha	.831	.905	.827	-	.891	.655	.820	.848	.840
Mean (SD)	6.71 (4.41)	23.2 (3.10)	21.87 (4.37)	1.90 (12.28)	4.92 (1.21)	3.26 (0.81)	3.03 (0.96)	4.16 (0.72)	4.20 (0.65)

Note: Amot= Amotivation, AM= Autonomous Motivation, CM= Controlled Motivation, RAM= Relative Autonomous Motivation, LC= Learning Climate, QQF= Quantity and Quality of Feedback, AS= Autonomy Satisfaction, RS= Relatedness Satisfaction, CS= Competence Satisfaction. * p < 0.05, ** p < 0.01

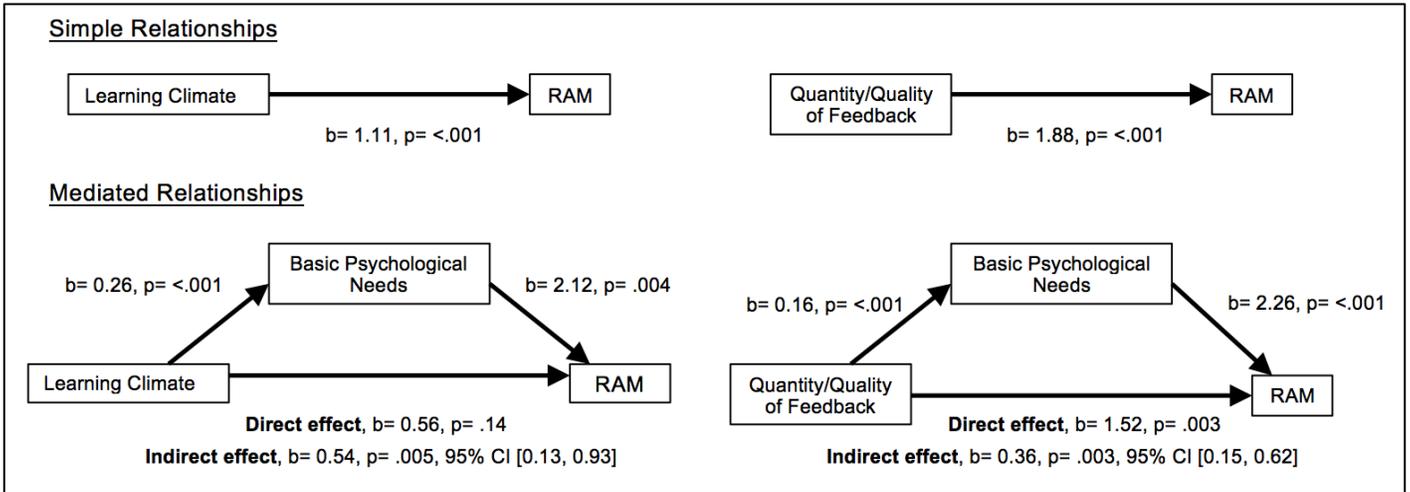


FIGURE 3 Simple and mediated (by basic psychological needs) regression models of learning climate and quantity and quality of feedback predicting relative autonomous motivation (RAM). The confidence intervals are BCa Bootstrapped CI based on 1000 samples.

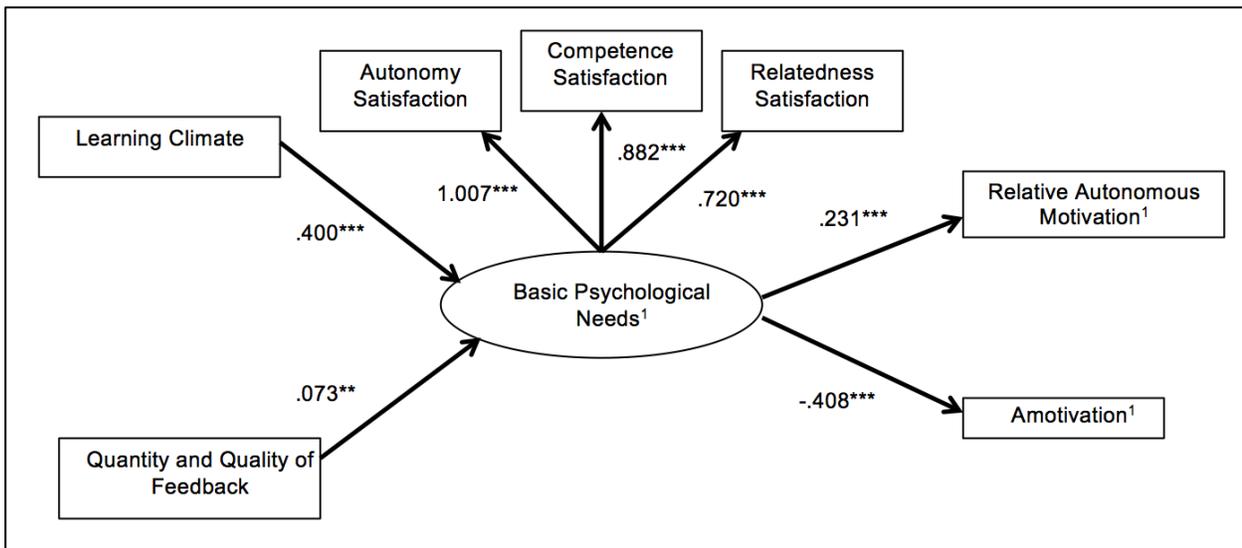


FIGURE 4 Structural equation model showing standardised regression coefficients amongst the hypothesised model for all students. Note: Residuals, covariances and regression paths of control variables have been omitted to simplify the model's visualization. Observable variables are represented with rectangles and latent variables with an ellipse. Significant differences are based on unstandardized regression coefficients. ¹Controlling for age, gender, and year of study. ** p < .01, *** p < .001.