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Associations between motivational factors for studying medicine, learning approaches and empathy among medical school candidates

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Advances in Health Sciences Education

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--Manuscript Draft--

Manuscript Number:	
Full Title:	Associations between motivational factors for studying medicine, learning approaches and empathy among medical school candidates
Article Type:	Original Paper
Keywords:	motivational factors; learning approaches; empathy; undergraduate medical students
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Funding Information:	
Abstract:	Previous research highlighted associations between students' motivation for medical studies and their learning approaches on the one hand and empathy on the other. Internal motivational factors for studying medicine (e.g., care for patients, save lives) coupled with a deep approach to learning have been positively related to empathy in contrast to external motivational factors (e.g., future earning potential, prestige) and surface learning. However, assessments of these assumptions among medical school candidates are scarce. This study examined the relationship between different motivational factors and empathy among students enrolled in a selection year in medicine by testing the mediating role of learning approaches. A sample of 572 candidates for medical studies answered a self-reported questionnaire half way through their selection year. Measures included internal and external motivational factors for studying medicine, deep and surface learning approaches and empathy. Path-analysis tested the mediation effects of deep and surface approaches to learning on the relationship of internal and external motivational factors with empathy. The deep learning approach partially mediated the significant positive association between internal motivational factors and empathy, while the surface learning approach fully mediated the significant negative association between external motivational factors and empathy. These results suggest that learning approaches could be a pathway by which internal and external motives for studying medicine are related to empathy among medical school candidates. Pedagogical strategies and educational environments accounting for individual differences in motivation and learning may contribute to training students to become professional and caring doctors in the future.

Abstract

Previous research highlighted associations between students' motivation for medical studies and their learning approaches on the one hand and empathy on the other. Internal motivational factors for studying medicine (e.g., care for patients, save lives) coupled with a deep approach to learning have been positively related to empathy in contrast to external motivational factors (e.g., future earning potential, prestige) and surface learning. However, assessments of these assumptions among medical school candidates are scarce. This study examined the relationship between different motivational factors and empathy among students enrolled in a selection year in medicine by testing the mediating role of learning approaches. A sample of 572 candidates for medical studies answered a self-reported questionnaire half way through their selection year. Measures included internal and external motivational factors for studying medicine, deep and surface learning approaches and empathy. Path-analysis tested the mediation effects of deep and surface approaches to learning on the relationship of internal and external motivational factors with empathy. The deep learning approach partially mediated the significant positive association between internal motivational factors and empathy, while the surface learning approach fully mediated the significant negative association between external motivational factors and empathy. These results suggest that learning approaches could be a pathway by which internal and external motives for studying medicine are related to empathy among medical school candidates. Pedagogical strategies and educational environments accounting for individual differences in motivation and learning may contribute to training students to become professional and caring doctors in the future.

Keywords: motivational factors; learning approaches; empathy; undergraduate medical students

MOTIVATION, LEARNING APPROACHES AND EMPATHY

Associations between motivational factors for studying medicine, learning approaches and empathy among medical school candidates

Motivation for studying medicine among medical students has been associated with a wide range of outcomes in the course of their studies, including learning approaches (Sobral, 2004), academic achievement (Firouznia et al., 2009), stress (Ahn et al., 2007), and quality of life (Lyndon et al., 2017). Internal motivational factors for entering medicine (such as helping others), are recognised as valuable indicators of professional identity growth (Wasityastutiet al., 2017), positive attitudes toward patients (Samra et al., 2017), and future career success (Kesternich et al., 2017), contrary to external ones (such as earning potential and job security) (Kusurkar et al., 2011). Despite such evidence, research into the association between the motivation for studying medicine and empathy, a crucial aspect for the development of professionalism in medical students (Boker et al., 2004) and a relevant correlate of clinical competence (Hojat et al., 2002), is currently scarce (Gonçalves-Pereira et al., 2013). Previous studies found that students with greater interest in people-oriented medical specialties reported higher levels of empathy (Chen et al., 2007; Hojat et al., 2005; Vaglum et al., 1999), and that psychosocial values including being empathic, patient-centred and sensitive to patients' psychosocial needs correlated with internal motives for studying medicine (Williams and Deci, 1996). Nevertheless, the relationship between motivation for medical studies and empathy remains partially unclear, especially among medical school candidates. Moreover, to the best of our knowledge, no study has yet investigated possible mediating mechanisms intervening between these constructs.

A consistent body of research has shown that different motivational factors predict different learning approaches among medical students and that these, in turn, can impact upon several educational outcomes (Ferguson et al., 2002; Kusurkar et al., 2013; Madjar et al., 2015; Sobral, 2004). Seminal work by Marton and Saljo (1976), Biggs (1987), and

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Marton (1983) distinguished between deep and surface approaches to learning, the former being associated with internal motivation and interest in the content of the task, and the latter based on external or instrumental motivation that perceive tasks as mere demands to be met (Chin and Brown, 2000). This dual operationalisation has been adopted in medical education research showing how a deep approach to studying increases performance results, in contrast to a surface approach (Feeley and Biggerstaff, 2015; Mattick et al., 2004), and that internal and external motives for medical training are associated with deep and surface approaches to learning, respectively (Delva et al., 2002).

Aspects of a deep approach to learning, such as self-development through reflective thinking, have also been associated to empathy development among medical practitioners in various specialties (Ahrweiler et al., 2014). Indeed, curiosity, relating new knowledge to personal experiences, and retaining facts for longer periods, are all characteristics of a deep learning approach that can facilitate the development of empathy when studying medicine (Burge, 2003). This process of *true learning* in medicine has been described by McLean (2001) to involve changing as a person, thus becoming more compassionate, sensitive and showing empathy. In fact, from the first year of studies in medicine, students embark upon a process of identity development and self-reflection, during which they endeavour to endorse the values and attitudes of being a doctor (Adams et al., 2006; Cruess et al., 2016; Niemi, 1997; Soo et al., 2016). Nevertheless, very few studies have tested the association between medical students' learning approaches and empathy. For example, Grosseman et al. (2014) reported that students who chose a problem-based learning track in medicine over a lecture-based one showed greater empathy. Moreover, McManus et al. (2006) found significant positive associations between deep strategic learning approaches and empathy, such as affective reactions in response to the experience of others, in a large sample of medical school applicants. Taken together, these results suggest that empathy among students wishing

to pursue a medical career may be associated with their approaches to learning from their early academic years. However, more research is needed to test this hypothesis, especially among medical school applicants. In particular, a more comprehensive approach to this issue should examine both negative and positive relationships between specific types of learning approaches and empathy by further considering their interrelations with students' individual characteristics such as motivational factors.

In summary, determining how motivation for studying medicine is associated with empathy among medical school applicants may inform pedagogical strategies aimed at supporting future professional development in medical students by focusing on empathy-related individual attributes that may improve emotional, communication and relationship skills. For medical education, motivation is indeed particularly important since evidence suggests that positively motivated individuals will eventually provide better quality health services (Goel et al., 2018). In addition, assessing the role of learning approaches in relation to empathy and how they modulate its relationship with motivation may further contribute to shed light on the diverse pathways of empathy development among students wishing to study medicine. In this study, we theorised that motivational factors, learning approaches and empathy may be interrelated characteristics among medical school candidates enrolled in a selection year in medicine. In the first place, students enter medical school driven by different motivational factors and approach their academic courses according to these personal predispositions and interests. Based on these interests, they may adopt different approaches to learning: some may be more inclined to learn in depth, while others may be more focused on meeting academic demands with the minimum effort. In turn, these differences may account for different capacities in developing empathy as a result of identity transformation processes and individual predispositions to acquiring the values of the medical profession throughout training. Accordingly, the present study aimed to test a mediation model of motivational

factors, learning approaches and empathy among medical school candidates. We hypothesised that internal motives for studying medicine and a deep approach to learning are positively associated with empathy, in contrast to external motives and a surface approach. In addition, we also tested whether the relationship between motivational factors for studying medicine and empathy is mediated by students' approaches to learning.

Methods

Participants and procedure

Participants were medical school candidates enrolled in the academic selection years 2011–2012 and 2012–2013 at the Faculty of Medicine in Geneva, Switzerland. These students were not selected before entering medical school as exam-based procedures decide who can continue after this selection year (Abbiati et al., 2016). Ten days before questionnaires were submitted, students received an email to inform them of the content of the research project and about their entitlements and commitments as voluntary participants. Information on confidentiality and privacy was also provided on this occasion. On the survey day – during the eighteenth week of the academic program – they received questionnaires (in French) in the interval between lectures and signed a consent form if they were willing to take part in the study. Participants provided their student ID in order to be matched throughout the duration of the study. This information also ensured that the students did not complete the same questionnaire twice across assessments in case they repeated the academic year. Researchers did not have simultaneous access to the data and student IDs, as the latter were managed by a technical administrator. The Chair of the Cantonal Commission for Ethical Research (CCER) designated the current study as exempted from formal review.

Measures

Motivational factors for studying medicine. Students were asked to indicate on a 6-point Likert scale (from 1 = *not important at all* to 6 = *very important*) how important they

considered the following 10 motives for studying medicine: vocation, mission, altruism, reward, prestige, academic activity, private practice, treating illness, caring for patients, and saving lives. This list of statements was finalised after reviewing the relevant literature on the issue of motivation when studying medicine (Crossley and Mubarik, 2002; Goel et al., 2018; Lefevre et al., 2010; Williams and Deci, 1996). A similar approach was adopted by Vaglum et al. (1999) when studying motivation for medical school in a nationwide sample of medical students in Norway. Based on this set of questions, using factor analysis with the principal factor axis method and oblimin rotation, we extracted two factors with eigenvalues larger than 1, explaining 40% of the total variance (KMO $p = 0.762$, Bartlett $p < 0.001$, items factor loadings ranging from $\beta = 0.31$ to $\beta = 0.80$). To further corroborate this two-factor solution of motivation, we conducted a confirmatory factor analysis based on the preliminary exploratory results. The following indexes were adopted to assess overall model fit: chi-square (χ^2) goodness-of-fit, Root Mean Square Error of Approximation (RMSEA; values ≤ 0.08 considered acceptable), Tucker–Lewis Index (TLI; values ≥ 0.90 considered acceptable), and Comparative Fit Index (CFI; values ≥ 0.90 considered acceptable). This model showed acceptable fit results: $\chi^2 (28) = 108.55$, $p < 0.001$, CFI $= 0.95$, TLI $= 0.92$, RMSEA $= 0.07$. The two retained factors were labelled according to the types of motivations grouped under them: internal motivational factors (6 items: vocation, mission, altruism, caring for patients, treating illness, and saving lives) and external motivational factors (4 items: reward, prestige, academic activity, and private practice). Cronbach's alpha reliability coefficients were equal to 0.80 and 0.60 for internal and external motives, respectively. Mean scores were calculated for both dimensions by adding up and averaging the scores of each related question.

Learning approaches. The Revised Two-Factor Study Process Questionnaire (R2-SPQ) (Biggs et al., 2001) was used to measure students' learning approaches. The R2-SPQ consists of 20 items scored on a 5-point Likert scale (from 1= *this item is never or only rarely*

true of me to 5 = *this item is always or almost always true of me*) evaluating two major types of learning approaches (each comprising 10 items): a deep learning approach (e.g., "I find that at times studying gives me a feeling of deep personal satisfaction"), and a surface learning approach (e.g., "My aim is to pass the course while doing as little work as possible"). The total scores for the deep and surface learning approaches were calculated by adding up the scores of all of the questions grouped under each dimension. Cronbach's alphas were equal to 0.76 for deep learning and 0.71 for surface learning. The reliability results of the French adapted version of the R2-SPQ used in the current study, created by two independent reviewers performing translation and back-translation, were aligned with the results of previous studies that used the English version of this instrument (Biggs et al., 2001; Socha and Sigler, 2014).

Empathy. The student's version of the Jefferson Scale of Empathy (JSE-S) (Hojat et al., 2001) was adopted to assess students' self-perceived empathy. The JSE-S has been widely adopted in medical research to measure self-reported empathy among medical students (Alcorta-Garza et al., 2005; Hojat, 2018; Preusche and Wagner-Menghin, 2013; Roh et al., 2010; Shariat et al., 2010). It comprises 20 items scored on a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*) (e.g., "Physicians should try to think like their patients in order to render better care"). A total score for empathy was calculated by adding up the answers to each question, after recalculating the reverse items which comprise half of the questionnaire. The current study adopted a French version of the JSE-S in order to adapt it to students and respecting the original JSE-S version in English by performing a back translation. This version showed comparable psychometric results with previous validation research (Abbiati et al., 2016; Zenasni et al., 2012). Here, Cronbach's alpha for empathy scores was equal to 0.73.

Covariates. Previous research found that older and female medical students tend to report greater empathy with respect to younger and male students (DiLalla et al., 2004; Neumann et al., 2011; Smith et al., 2017). Moreover, these sociodemographic characteristics together with parental educational background have been found to be significantly associated with deep and surface approaches to learning among university students (Hall et al., 2004; Zeegers, 2001; Zhang, 2000). Accordingly, age, gender (1 = *male*, 2 = *female*), and parental educational levels (1 = *low/obligatory school*, 2 = *medium/high school diploma*, 3 = *high/university degree*) were included in the analyses as covariates.

Data analyses

Stata 15 (StataCorp. 2015. Stata Statistical Software: Release 15. College Station, TX: StataCorp LP) was used for data analyses. As a preliminary check, data were examined for missing values, normality assumption and multicollinearity. Subsequently, using path analysis we tested the proposed mediation model (Figure 1). Reading from recommendations for testing interaction effects (Edwards and Lambert, 2007; Preacher et al., 2007), we initially tested the possible moderating effects of the covariates included in our model on the relationship between motivation and learning variables with empathy. We achieved this by adding interaction terms between the standardised scores of each exogenous (i.e., internal and external motivational factors) and mediating (i.e., deep and surface learning) variable with every covariate. Non-significant associations between these terms with empathy indicated the absence of moderating mechanisms. The mediation effects were then computed following the bootstrapping method described by Preacher and Hayes (2004) which allows confidence intervals around the estimated indirect effects to be computed and reduces the risk of obtaining unbiased mediation estimates. The present study employed this bootstrapping method using 2,000 iterations, as suggested by other researchers (Johnson et al., 2011), and reported 95% Confidence Intervals (CI_{95}). RMSEA, TLI and CFI fit indexes were adopted to

assess model acceptability. The percentage of explained variance in empathy attributable to each mediator was calculated by dividing the indirect effects by the total effects that were obtained by adding up the direct and indirect effects. Finally, in order to provide a stringent test of our model (Platt, 1964), we compared its fit results with those from alternative solutions. First, motivational factors were set to be the mediators of the relationship between empathy and learning approaches. Subsequently, empathy was set to mediate the relationship between motivational factors and learning approaches. In addition, we tested the significance of the mediated effects by different variables other than learning strategies. To determine which model fitted the data best, we looked at differences in Akaike's information criterion (AIC) between different solutions, with lower values being indicative of a better fit (Royston, 2001).

Results

Descriptive statistics

Out of the 922 students of medicine enrolled during the selection academic years 2011–2012 and 2012–2013, 767 (83%) were present during lectures when the questionnaires were distributed. Of these, 614 (80%) agreed to participate in the survey. Forty-two students were excluded from analyses because of missing data (24 students failed to complete the identity code number and 18 had missing values on more than half of the variables included in the model), which left 572 students for the analyses. Little's test for data missing completely at random (MCAR), applied to the entire set of variables included in the analyses, was not significant ($\chi^2 = 174.11$, $df = 158$, $p = 0.180$), indicating that data were MCAR (rates of missing per variables ranged from 0 to 9%). Accordingly, we used the maximum likelihood estimation method in the mediation analyses to deal with the problem of missing values. This decision was supported by investigating absolute values of skewedness and kurtosis that ranged respectively from 0.08 to 1.68 and from 3.05 to 7.77, thus suggesting that

scores on all psychological variables included in the model were normally distributed, also

considering our large sample size (Kline, 2015). Table 1 reports the sociodemographic and

background sample characteristics.

A check of the assumption of multicollinearity (using a correlation threshold of |0.80|

as an index of absence of multicollinearity) (Field, 2009) showed that correlations between

endogenous variables in the model were small to moderate in magnitude (ranging

from $r = |0.01|$ to $r = |0.47|$), indicating that each set of questions measured different latent

constructs (Table 2). In order to control for residual associations between similar constructs,

correlations between independent variables (i.e., internal and external motives) and between

mediators (i.e., deep and surface learning approaches) were estimated in the mediation

analyses.

Overall, students from the current sample reported greater endorsement of internal

motivational factors for studying medicine in contrast to external ones, as well as using

deeper learning approaches instead of surface approaches to study (Table 2).

Mediation model and mediation effects

Age, gender, maternal educational level and paternal educational level were included

in the final model as exogenous variables that are free to co-vary with each other since no

moderating effect of these variables was observed by examining interactions with

motivational factors or learning approaches. The resulting mediation model showed

satisfactory fit results, $\chi^2 (2) = 1.73$, $p > 0.05$, CFI = 1.00, TLI = 1.02, RMSEA = 0.00. Figure

1 depicts the model along with beta weights. Table 3 reports unstandardised, standardised,

and significance levels for the overall mediation model.

The deep learning approach mediated the association of internal motivational factors

with empathy (mediated effect = 0.21; CI$_{95}$: 0.01, 0.51), while the surface learning approach

mediated the association of external motivational factors with empathy (mediated effect = -

9

0.18; CI$_{95}$: -0.39, -0.01). The direct path from internal motivational factors to empathy remained significant at $p < 0.001$ when the mediator deep learning approach was entered in the model, indicating that the latter partially mediated this relationship. Conversely, the direct path from external motivational factors to empathy was significant at $p < 0.05$ only when the mediator surface learning approach was excluded from the model. Thus, we can conclude that the surface learning approach fully mediated this second association. The two mediators combined accounted for approximately 27% of the total explained variance in empathy. Specifically, the deep learning approach accounted for approximately 8% of the variance in empathy, while the surface learning approach accounted for approximately 19%.

Two alternative models were tested to support the validity of the current one. The first alternative model where motivational factors were set to be the mediators between empathy and learning approaches (AIC = 18,265.22) did not fit the data better than the chosen one (AIC = 18,262.95). Moreover, both types of motivations for studying medicine failed to mediate this relationship. Finally, the second alternative model, where empathy was set to be the mediator between motivational factors and learning approaches, yielded a slightly worse fit results (AIC = 18,263.07), with the only significant mediating effect of empathy being the one between internal motivational factors and the deep learning approach. In summary, these results indicate that learning approaches are more suitable for the role of mediators than motivational factors or empathy.

Discussion

The aim of this study was to test the relationship between motivational factors for studying medicine among medical school candidates and their levels of self-reported empathy while further testing a mediating role of individual differences in learning approaches. The results confirmed our initial hypotheses: internal motivational factors for studying medicine are associated with higher empathy levels via a deep approach to learning, while external

motivational factors are associated with lower empathy levels via a surface approach to learning. The association of internal motivational factors with empathy remained evident after controlling for the mediators in our model, whereas the surface learning approach served as a full mediator between external motives and empathy. Thus, deep and surface learning approaches acted as partial and full mediators of such a relationship, respectively, providing an explanation for the phenomenon linking motivational factors and empathy among undergraduate medical students.

Cognitive or emotional dissonance may occur when students have ideas about their future professional role that are not in accordance with what is taught to them (Helmich and Dornan, 2012; Thompson et al., 2010). In this sense, their motivation when entering medical school may guide them toward a preconceived path of professional identity to which empathy is associated. In turn, their learning approaches may be a reflection of how they react to contents that differ from their own aspirations. Previous research has indeed underlined the positive role of other-oriented reasons for studying medicine (e.g., helping others, saving lives) on self-reported levels of empathy (Gonçalves-Pereira et al., 2013; Williams and Deci, 1996). On the other hand, to the best of our knowledge, only one previous study looked at the association between deep and surface learning approaches with empathy (i.e., McManus et al., 2006). Our analyses expand such findings by showing that learning approaches may further act as mediators between motivation and empathy. Moreover, these results support earlier research associating learning approach characteristics, such as investing adequate time to self-reflect on the acquisition of new knowledge, to the development of empathy among medical students (Ahrweiler et al., 2014; Stepien and Baernstein, 2006; Tavakol et al., 2012; Winseman et al., 2009). For example, Rosenthal et al. (2011) suggested that educational programs where medical students are given the opportunity to share observations and reflect upon positive and negative role models can preserve empathy. On a related note, Charon

(2001) highlighted the relevance of strengthening the role of deep learning approaches such as reflection and self-awareness in medical academic curricula as tools to practice medicine with more empathy. Our model confirmed these positions by showing how learning approaches might be associated with empathy and may reinforce its relationship with both internal and external motivational factors for studying medicine.

From the early years of medical training, students follow different pathways of professional identity as physicians (Adams et al., 2006; Cohen et al., 2009; Cruess et al., 2016; Niemi, 1997; Soo et al., 2016). Results from the current study might contribute to highlight the multiple facets of this developmental process that students undergo in order to assume their professional identity and which involves modifiable individual characteristics such as motivational factors for studying medicine and learning approaches (Pelaccia and Viau, 2017; Reid et al., 2005). The relevance of our findings lies in the potential to influence empathy development, which is a strong indicator of future professionalism and clinical competence among medical students (Boker et al., 2004; Hojat et al., 2002). While motivational factors for studying medicine seem difficult to influence as they exist before entering medical school, learning approaches can be modified by educational programs and pedagogical interventions (Baeten et al., 2010; Dart et al., 2000). Further studies should focus on the impact of strategies to reinforce deep learning approaches early in medical students' careers, in order to favour the progressive assimilation of essential professional attitudes, including empathy. This is of particular importance in the specific case of medical school candidates, given the growing attention among medical schools to selecting students not just through knowledge-based examinations but also considering their empathic attributes (Griffin, 2018).

However, some limitations of the present study need to be mentioned. First, the cross-sectional nature of the analyses prevents the assessment of causal relationships between the

observed variables. Future studies should longitudinally test the mediation hypothesis examined here, as well as replicate our findings in subsequent years of medical studies and in multiple contexts. Concurrently, replications among medical students who successfully pass selection years are desirable. Second, our conclusions are based on a single measure of self-reported empathy, namely the JSE-S. Empathy is a complex and multi-faceted concept; therefore, the results might change depending on the instrument used to measure this construct. On a related note, standardized measures of motivation may also be used to further validate the model tested here. Finally, considering how high stakes are among medical school candidates during their selection year, we cannot exclude social desirability biases from our results. Since students' performances in this year will determine whether they can continue their medical training, their responses may have been chosen to project a more favourable image of themselves, although participants acknowledged before taking part in the study that researchers would not have access to the data linking the responses to the students' identity, as the latter was managed by a technical administrator.

In summary, this study might contribute to the understanding of positive as well as negative psychological correlations of empathy among medical school candidates. Our findings may support pedagogical strategies that account for and focus on students' individual differences with regard to motivation and learning, by promoting deep approaches to learning and enhancing internal motivational factors for studying medicine. Such strategies might help to better train students to become professional and caring doctors in the future.

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MOTIVATION, LEARNING APPROACHES AND EMPATHY	1

Table 1

Sociodemographic and background sample characteristics (N = 572). Values are frequencies

(percentages) unless stated otherwise

Variables	
Age *Mean years (SD)*	20.55 (1.74)
Females	369 (64)
Mother educational level	
Low (Secondary school diploma)	49 (9.3)
Medium (High school diploma)	156 (29.4)
High (University degree)	323 (61.3)
Father educational level	
Low (Secondary school diploma)	46 (8.7)
Medium (High school diploma)	125 (23.9)
High (University degree)	353 (67.4)

Table 2

Descriptive statistics and Pearson's correlations for all variables included in the model (N = 572)

	Mean (SD)	Range	1	2	3	4	5	6	7	8
1. Age	20.55 (1.74)	17–38	-							
2. Female			-0.12**	-						
3. Mother educational level			-0.01	-0.08	-					
4. Father educational level			-0.03	-0.08	0.50***	-				
5. Internal motives	5.11 (0.79)	1–6	-0.07	0.14**	-0.04	-0.06	-			
6. External motives	3.89 (0.92)	1–6	0.03	-0.06	-0.09*	-0.05	0.13**	-		
7. Deep learning approach	32.46 (5.94)	12–50	0.11*	-0.07	-0.01	-0.06	0.08	-0.03	-	
8. Surface learning approach	23.29 (5.62)	10–47	0.05	-0.02	-0.06	-0.01	-0.03	0.21***	-0.47***	-
9. Empathy	111.86 (9.82)	76–140	0.05	0.20***	0.04	-0.01	0.22***	-0.08	0.23***	-0.21***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 3

Unstandardized, standardized estimates and significance levels for the overall model

(standard errors in parentheses; N = 572)

Structural model estimates	Standardized	Unstandardized	p
Internal motivational factors → Deep learning approach	**0.10**	**0.77 (0.34)**	**0.023**
Internal motivational factors → Surface learning approach	-0.07	-0.47 (0.32)	0.143
Internal motivational factors → Empathy	**0.20**	**2.48 (0.52)**	**< 0.001**
External motivational factors → Deep learning approach	-0.05	-0.34 (0.29)	0.235
External motivational factors → Surface learning approach	**0.22**	**1.33 (0.27)**	**< 0.001**
External motivational factors → Empathy	-0.07	-0.76 (0.47)	0.103
Deep learning approach → Empathy	**0.15**	**0.25 (0.07)**	**0.001**
Surface learning approach → Empathy	**-0.12**	**-0.22 (0.07)**	**0.010**
Age → Deep learning approach	**0.11**	**0.36 (0.13)**	**0.014**
Age → Surface learning approach	-0.05	-0.18 (0.16)	0.203
Age → Empathy	0.07	0.39 (0.19)	0.081
Female → Deep learning approach	-0.07	-0.91 (0.53)	0.093
Female → Surface learning approach	0.03	0.32 (0.43)	0.530
Female →Empathy	**0.18**	**3.77 (0.79)**	**< 0.001**
Mother education → Deep learning approach	0.02	0.20 (0.52)	0.685
Mother education → Surface learning approach	-0.03	-0.27 (0.50)	0.546
Father education → Deep learning approach	-0.06	-0.50 (0.47)	0.685

Father education → Surface learning approach	-0.01	-0.06 (0.47)	0.887
Internal motivational factors ←→ External motivational factors	**0.13**	**0.10 (0.03)**	**0.002**
Deep learning approach ←→ Surface learning approach	**-0.47**	**-15.09 (1.71)**	**< 0.001**

Notes. Select fit indexes are $\chi^2 (2) = 1.73$; $p > 0.05$, CFI = 1.00, TLI = 1.02, RMSEA = 0.000.
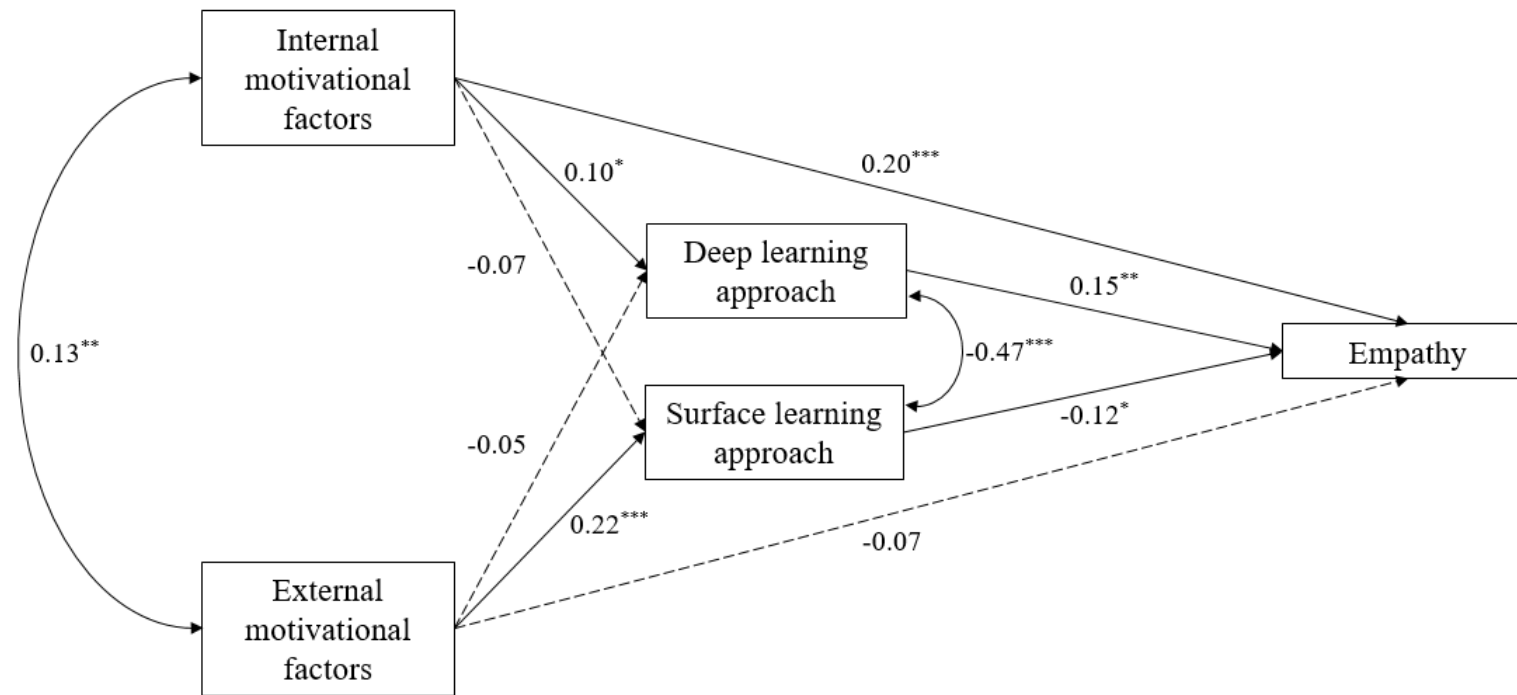
Figure 1. Mediation path-analysis model depicting learning approaches acting as mediators of the relationship between motivational factors for

studying medicine and empathy among medical students. Standardized coefficients are shown (N = 572)

Notes. Select fit indexes are $\chi^2 (2) = 1.73$, $p > 0.05$, CFI = 1.00, TLI = 1.02, RMSEA = 0.00. The following covariates and their regression

coefficients were not displayed for graphical reasons: age, gender, mother educational level and father educational level.

$^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Associations between motivational factors for studying medicine, learning approaches and empathy among medical school candidates

Answers to Medical Education Editor' and Referees' comments
(received February the 15th, 2018)

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Editor's comments

This was an interesting, reasonably well-written, manuscript that explored the relationships between motivation (to become a physician), empathy, and learning styles. While the topic area would certainly be of interest to the ME readership, the justification of the model, and the applicability of the results, could be questioned.

1. *While the authors have done a very thorough review of the literature, both reviewers felt that the final model, at least theoretically, was not fully justified. One could imagine that there are both recursive and non-recursive relationships. More important, while acknowledged in the limitations, the authors base their analyses on cross-sectional data. To fully understand the relationships, and the mediating effects of one variable or another, longitudinal investigations are required.*

ANSWER: In the revised version of the manuscript we have focused on strengthening the theoretical justification of our model. In the introduction section, we reported previous research findings specifically pointing out to the associations between motivational factors and empathy (Gonçalves-Pereira, Loureiro, Trancas, Papoila, & Caldas-de-Almeida, 2013), between motivational factors and learning approaches (Ferguson, James, & Madeley, 2002; Delva, Kirby, Knapper, & Birtwhistle, 2002 ; Kusurkar, Croiset, Galindo-Garré, & Ten Cate, 2013; Madjar, Kushnir, & Bachner, 2015; Sobral, 2004), and between learning approaches and empathy (Ahrweiler, Neumann, Goldblatt, Hahn, & Scheffer, 2014; Grosseman, Hojat, Duke, Mennin, Rosenzweig, & Novack, 2014; McManus, Livingston, & Katona, 2006). In our model we particularly focused on addressing these set relationships in light of such previous research literature by testing the mediation hypothesis according to which learning approaches mediate the association between motivational factors and empathy. While the single associations in the model are based on previous findings, our mediation hypothesis is novel and relies on the concepts of *true learning* in medicine and students' identity development as future physicians (Adams, Hean, Sturgis, & Clark, 2006; Cruess, Cruess, & Steinert, 2016; McLean, 2001; Niemi, 1997; Soo, Brett-MacLean, Cave, & Oswald, 2016), a process that involves changing as a person, thus becoming more compassionate, sensitive and showing empathy. We argued that medical students' motivations when entering medical school may guide them toward a preconceived path of professional identity to which empathy is associated. In turn, their learning approaches may be the reflection of how they react to contents that differ from their own aspirations. In this sense, we may be able to observe not just single associations between these variables, but a relationship between motivation and empathy that is modulated by learning. Methodologically speaking, we have compared

1

results from alternative models in order to provide a stringent test of our solution, arriving to the conclusion that learning approaches are more suitable for the role of mediators than motivational factors or empathy. A better explanation of this analyses is now reported in the Analyses and Results sections. Finally, we agree that a major limitation of our paper is its cross-sectional design, therefore we made sure to fully address this issue among the limitations and to avoid statements in the text that would refer to causal relationships, such as 'predict' or 'affect'.

2. *As noted by reviewer 1, the authors should explain how (or whether) the traits they measured are related to admission decisions. If they are, the students may have just been filling out the questionnaires with socially acceptable responses – not their true feelings.*

ANSWER: Using t-tests for independent samples we noticed that the two sub-groups of students (selected vs. not selected) in our current sample differed only regarding the reported levels of surface learning approaches that were higher in the not selected group (see Table A). However, we do agree about the importance of addressing the risk of social desirability biases, therefore we made sure to clearly state this in the limitations as well as to specify that participants were acknowledged before to take part to the study that researchers will not have access to the data linking responses to students' ID, the latter being managed by a technical administrator.

3. *Reviewer 1 also suggests that other models are viable. These could be tested and contrasted (with respect to fit).*

ANSWER: As reported above, we have compared results from alternative models in order to provide a stringent test of our solution. To determine which model fitted the data best, we looked at differences in Akaike's information criterion (AIC) between different solutions with lower values being indicative of better fit (Royston, 2001). A full explanation of this analysis is now reported in the Data analyses (cfr. p. 8, end of first paragraph) and Results sections (p. 10, second paragraph).

4. *Reviewer 1 also mentions possible limitations of the factor analysis. To me, if you really believed in a 2 dimensional structure, then why not test this via confirmatory FA. The exploratory analysis is not really needed (unless you had no idea about the dimensional structure).*

ANSWER: We did not have any a priori assumption about factorial dimensionality when we first constructed our questions regarding motivational factors to study medicine. However, we created this list to cover a wide range of different motives when entering medicine so that a synthesis into more general factors was theoretically plausible. Therefore, we tested this possibility using exploratory factor analysis. As specified in the Measures section, such list of statements was finalized after reviewing relevant research literature on the issue of motivation when studying medicine (Crossley & Mubarik, 2002; Goel et al., 2018; Lefevre, Roupret, Kerneis, & Karila, 2010; Williams & Deci, 1996). A similar approach was adopted by Vaglum et al. (1999) when studying motivation for medical school in a nationwide sample of medical students in Norway.

5. *Reviewer 2 comments that the study really does not "shed light" on the protective and deteriorating factors for empathy. First, there may be a host of variables (not measured as*

*part of this investigation) that are related to empathy. Second, the causal chain is
longitudinal, not cross-sectional.*

ANSWER: We agree that this statement was too strong given the correlational nature of our
analyses. We rephrased this sentence at the end of the Discussion section, as follows:

[…] this study might contribute to the understanding of positive as well as negative
psychological correlations of empathy among medical school candidates.

Moreover, we fully acknowledged that with the cross-sectional nature of our data we could
not address any causal relationship among the presented variables, and we also reminded in
the limitations that results from our current model may change using or adding different
standardized scales (for example regarding motivation) (cfr. pp. 12-13). Nevertheless, given
the novelty of our findings and their potential to contribute to the debate about the
psychological correlates of empathy among medical students, we highlighted the need to
further test our cross-sectional findings using longitudinal data.

6. *While not specifically noted by either reviewer, there are a few other issues that warrant
   attention. First, other than what is referenced in the manuscript, was other data
   collected? It seems that the model was fashioned from the data collected – not based on a
   priori hypotheses. Second, it is not exactly clear (to me) how the
   medical educational community would benefit from this investigation. Are you planning on
   changing the criteria used to select medical students? For example, only select student
   with deep learning approaches thinking they may be more empathetic? Third, I suspect
   that your FA, and possibly the SEM as well, are impacted by non-normal distributions of
   the data. Finally, it's not really clear how you employed your covariates. You could
   conduct a multi-group SEM (e.g., based on gender) and compare the results.*

ANSWER: This research is part of a larger project currently conducted by the Unit of
Development and Research in Medical Education (UDREM) at Faculty of Medicine in
Geneva (Switzerland). This project aims at following medical students across the entire
course of their medical degree by collecting information regarding their individual
characteristics such as motivation, learning, empathy as well as evaluating the impact of these
characteristics and of the learning environment on their academic performance and future
academic choices. While longitudinal data collection is still in progress, a previous paper has
been already published on the cross-sectional data (Abbiati, Baroffio, & Gerbase, 2016)
without addressing the specific research questions we explored in this current manuscript.
Among available information within the framework of this larger project we choose the
variables that could help us to answer our specific research questions and hypotheses, namely
if motivational factors for studying medicine and learning approaches are related to empathy
among medical students and if the learning approaches may act as mediators between
motivation and empathy.

As we have previously observed (Abbiati, Baroffio, & Gerbase, 2016), selected
students do not differ from not selected students in terms of empathy, nevertheless we are
currently assisting to a growing attention among medical schools for selecting students not
just through knowledge-based examinations but also considering their empathic attributes
(Griffin, 2018). It is thus important to start promoting students' development of empathy
already during selection years. Therefore, with the current study we aimed at investigating
the psychological correlates and mechanisms behind empathy in a population of medical
school candidates, with the aim of producing evidence to support pedagogical curricula and

3

educational environments that might contribute to better train students for becoming professional and caring doctors in the future already since the early years of their studies.

In the revised version of this paper we have reported additional information addressing the normality assumption of the psychological variables included in our model. More specifically, reading from recommendation from Kline (2015), scores on all psychological variables included in the model were reasonably normally distributed, considering also our reasonably large sample size (cfr. pp-10-11).

Finally, before to include our covariates (age, gender, father and mother educational level) in the final model as exogenous variables, we tested their possible moderating effects on the relationship between motivation and learning variables with empathy by following recommendation from Edwards and Lambert (2007) and from Preacher, Rucker, and Hayes (2007). More specifically, we did so by adding interaction terms between the standardized scores of each exogenous (i.e., internal and external motivational factors) and mediating (i.e., deep and surface learning) variable with every covariate. The non-significant associations between these terms with empathy indicated the absence of moderating mechanisms, therefore we proceeded to add the covariates as independent variables free co-vary with each other.

Table A. Descriptive statistics for all psychological variables included in the analyses and results of tests (t-tests) for significant differences between selected and not selected students. Values are means (standard deviations) unless stated otherwise (N = 572)

Variables	Successful (58%)	Not successful (42%)	p
Internal motivational factors	5.07 (.81)	5.15 (.79)	.295
External motivational factors	3.88 (.91)	3.84 (.92)	.682
Deep learning approach	33.07 (5.50)	32.05 (5.91)	.055
Surface learning approach	22.61 (5.03)	23.78 (5.76)	**.018**
Empathy	112.41 (9.40)	111.89 (9.88)	.550

Notes. Significant *p* values are marked in bold.

Referees' comments

OVERALL EVALUATION AND GENERAL COMMENTS (Q1)

Referee: 1
Q1: *This paper seems like it might be part of a larger project (which is OK), but I'm not sure that including a little bit more data from that might make a far more compelling package. The research is conducted in a competitive pre-entry year, but we don't know which of the traits is associated with students going on to gain entry to the programme. If for example, the internally motivated, deep learning students, with higher empathy, are overwhelmingly accepted, then there seems little need to do anything. However, if the opposite result is true, then more action is required.*
Therefore, I'd recommend that this paper makes a clearer justification of its purpose, ideally linked to whether any of the measured variables are associated with admission.

ANSWER: As we have previously noted (Abbiati, Baroffio, & Gerbase, 2016), selected students do not differ from not selected students in terms of internal motivation, deep learning strategies or empathy. In the current study, using t-tests for independent samples we noticed that the two sub-groups of students (selected vs. not selected) in our sample differed

4

only regarding the reported levels of surface learning approaches that were higher in the not selected group (see Table A). In Geneva, Switzerland, admission to medical school is free and students are actually selected at the end of their first study year. Students are selected on the basis of their scores on an end-of-first-year knowledge-based MCQ exam. In this context, the challenge remains to enhance students' qualities such as empathy already since their early academic years. The fact that these two sub-groups of students (selected vs. not selected) are substantially similar for what concerning the variables included in our model support the decision to analyse them together. As we strived to better explain in the revised version of our paper, empathy is still a very discussed topic in the research field of medical education, given the fact that it is a strong indicator of future professionalism and clinical competence among medical students (Boker et al., 2004; Hojat et al., 2002). Understanding both positive and negative psychological correlates of empathy among university students that chose to study medicine, including students' individual differences in motivation and learning, may thus support pedagogical curricula and educational environments that might contribute to better train students for becoming professional and caring doctors in the future.

Referee: 2
Q1: *This paper investigates the relations between motivation (internal/external), learning (deep/surface) and empathy among students in the pre-selection year for medical education. There is increasing attention for the importance of motivation and empathy in medical training, and of course, the learning of students is also crucial. Understanding the mechanism is therefore important. This study hypothesizes and tests a model using SEM. There seem to be some methodological issues that need to be resolved or better substantiated.*

TITLE AND ABSTRACT (Q2)

Referee: 1
Q2: *Second sentence is difficult to understand, because the comparison clause is abbreviated. Perhaps replace the phrase starting with "contrary", "... and the corollary, external motives and surface learning were associated with lower empathy." Also, "learn" should be "learning" in that same sentence. Missing "%" symbol after 64. Re-write conclusion to more clearly articulate your main argument. Country in which study is conducted should be mentioned.*

ANSWER: We revised the text as recommended and rephrased sentences where necessary:

"Internal motivational factors for entering medicine (such as helping others), are recognised as valuable indicators of professional identity growth (Wasityastutiet al., 2017), positive attitudes toward patients (Samra et al., 2017), and future career success (Kesternich et al., 2017), contrary to external ones (such as earning potential and job security) (Kusurkar et al., 2011)." (p. 1)

Referee: 2
Q2: *The abstract is a good representation of the study. As a result, the comments on the main text apply to the abstract as well and mainly pertain to the hypothesized causality (see below).*

INTRODUCTION AND CONCEPTUAL FRAMEWORK (Q3)

Referee: 1
Q3: *Make a clearer argument about why motivations should drive learning approach and subsequently empathy (see also notes on clarity). It seems causality could easily run in the reverse direction, that a more empathic person would have higher internal people-focussed motivations, and that this would be linked with deeper learning.*

ANSWER: Based on previous research findings, we made a clearer argument about the fact that motivational factors predict learning approaches among medical students (Ferguson, James, & Madeley, 2002; Kusurkar, Croiset, Galindo-Garré, & Ten Cate, 2013; Madjar, Kushnir, & Bachner, 2015; Sobral, 2004). However, there is less evidence regarding the connection between motivation (Gonçalves-Pereira, Loureiro, Trancas, Papoila, & Caldas-de-Almeida, 2013) and learning approaches (Grosseman et al., 2014; McManus, Livingston and Katona, 2006) with empathy, especially for what concerning the direction of these relationships. One can argue that motivation acts on empathy based on the self-determination theory of motivation (Deci & Ryan, 1985), and this argumentation is followed by previous research according to which motivational factors (internal or external) as reflected for example by preferences for specific specialties (i.e., other-oriented vs. technology-oriented) may explain empathy among medical students (Chen, Lew, Hershman, & Orlander, 2007; Hojat et al., 2005). This proposition is reflected by the types of analytical approaches in previous studies, where empathy is set to be the dependent variable. A similar argumentation can be sustained when looking at previous studies pointing out to a relationship between medical students' preferences for learning approaches and empathy (Grosseman et al., 2014; McManus, Livingston and Katona, 2006). More specifically, Grosseman and colleagues (2014), reported that students choosing a problem-based curricular track instead of a lecture track one were higher in empathy (measured by the JSE-S). Concurrently, McManus and colleagues (2006) pointed out that when hypothesizing a causal ordering between learning styles and empathy, it is difficult to place this latter *a priori*. Accordingly, in the revised version of our paper, we further elaborated upon our hypotheses in the Introduction section by drawing from such previous research findings (cfr. p. 2, second paragraph).

Referee: 2
Q3: *To me it remains unclear how the authors come to the hypothesized model. I understand the left part (motives - learning approach) and the relation between motives and empathy, but I have my doubts about the relation between the learning approach and development. The authors do not currently succeed in convincing me of their hypothesized model in which learning approach is expected to influence empathy (and mediate the relation between motivation and empathy). The references that they cite do not seem to clearly indicate that there was a relation found between deep/surface learning and empathy. Furthermore, learning and empathy may be related, but I have not seen evidence for the hypothesized direction. The authors do not sufficiently substantiate their hypothesis in my opinion. Furthermore, I would expect separate figures for the hypothesized model and the final model. Furthermore, I don't understand their statement about how motivation, learning and empathy can be placed on a continuum.*

ANSWER: Please see our previous answer to Referee 1 who also pointed out the need to better clarify theoretically our research hypotheses. For what concerning the addition of further figures, we tried to better phrased our hypotheses in the revised version of the paper without adding any figure. We remain nevertheless available to do so if considered necessary.

Finally, we rephrased the statement about how motivation, learning and empathy can be placed on a continuum as follows:

"In this study, we theorised that motivational factors, learning approaches and empathy may be interrelated characteristics among medical school candidates enrolled in a selection year in medicine." (p. 3)

METHODICAL RIGOUR (Q4)

Referee: 1
Q4:
1. *Strict methodologists would argue that mediation can't be demonstrated in a cross-sectional study. In addition to more clearly noting this as a limitation, considering the possible of the reverse causal direction noted above (ie empathy is the causal factor), could be considered.*

ANSWER: As reported above, we made sure to clearly state in the limitation that only replication with longitudinal data can fully validate our hypothesis. Moreover, we have compared results from alternative models in order to provide a stringent test of our solution. To determine which model fitted the data best, we looked at differences in Akaike's information criterion (AIC) between different solutions with lower values being indicative of better fit (Royston, 2001). A full explanation of this analysis is now reported in the Data analyses (cfr. p. 8, end of first paragraph) and Results sections (p. 10, second paragraph).

2. *Should clearly spell out at least the country in which this research occurred (Switzerland?).*

ANSWER: We added this information in the Methods section (cfr. p. 7).

3. *The translation of some scales is discussed, but not all; but I presume the whole study was administered in French?*

ANSWER: The whole study was conducted in French. Validation information on the French translation of each adopted instrument has been added in the Measures sections (cfr. p. 6).

4. *Factor analysis – What factor method was used? Typically, an oblique rotation should be first used (e.g., Oblimin), and only if the extracted factors are uncorrelated should an orthogonal rotation be used.*

ANSWER: We used a factor analysis with principal factor axis method and oblimin rotation. More information about the factorial solution is reported in the Measures section (cfr. p. 5).

5. *Cronbach's alpha is no longer considered to be a valid measure of reliability (e.g. Sitjsma, 2009 http://link.springer.com/article/10.1007/s11336-008-9101-0); try McDonald's Omega instead.*

ANSWER: We thank the reviewer for this suggestion. In the revised version of our manuscript we still reported Cronbach's alpha since it is widely used in the psychometric

literature as an index of internal consistency reliability of a scale. We remain nevertheless available to add McDonald's Omega if necessary.

6. *Motivation scores are presented as means of items (out of 6), whereas learning style scores are sum scores (out of ?), and empathy is on a different scale again. Percentage of Maximum Possible (POMP) scores are a well regarded way to present these in a more informative and standardised way* *http://www.tandfonline.com/doi/abs/10.1207/S15327906MBR3403_2*

ANSWER: The two learning styles scores (deep and surface) are sums of 10 items each. We remain available to add information such as Percentage of Maximum Possible (POMP) scores in our revised paper.

7. *Some participants were excluded for high levels of missing data. What treatment was used for participants with lower levels of missing data?*

ANSWER: More information was reported in the descriptive statistics in the Results section about missing values and how to deal with them:

"Little's test for data missing completely at random (MCAR) applied to the entire set of variables included in the analyses was not significant ($\chi^2 = 174.11$, $df = 158$, $p = .180$), indicating data were MCAR (rates of missing per variables ranged from 0 to 9%). Accordingly, we used the maximum likelihood estimation method in the mediation analyses to deal with the problem of missing values. This decision was supported by investigating absolute values of skewness and kurtosis that ranged respectively from .08 to 1.68 and from 3.05 to 7.77, thus suggesting that scores on all psychological variables included in the model were reasonably normally distributed, considering also our large sample size (Kline, 2015)." (pp. 8-9).

Referee: 2
Q4:

1. *The methods have been clearly described. I do wonder why the authors have not used one of the many existing validated motivation scales, but instead used their own items. They may have a good reason, but this is not explained. They themselves mention this as a limitation to the study.*

ANSWER: As now better specified in the Measures section (cfr. p. 5), such list of statements was finalized after reviewing relevant research literature on the issue of motivation when studying medicine (Crossley & Mubarik, 2002; Goel et al., 2018; Lefevre, Roupret, Kerneis, & Karila, 2010; Williams & Deci, 1996). A similar approach was adopted by Vaglum et al. (1999) when studying motivation for medical school in a nationwide sample of medical students in Norway. As we stated in the response to Editor's comments, we did not have any a priori assumption about factorial dimensionality when we first constructed these set of questions. However, we created this list to cover a wide range of different motives when entering medicine so that a synthesis into more general factors was theoretically plausible. Therefore, we tested this possibility using exploratory factor analysis.

2. *The authors currently mention in the results section that they tested two alternative models. This should be included in the method section. Furthermore, can the authors include a reference showing that this is customary when conducting SEM?*

ANSWER: We have now included this information at the end of the Data analyses section (cfr. p. 8).

3. *Most importantly, I wonder whether SEM is the correct approach to study the mechanism because I am not sure that I can agree with the hypothesized model (but maybe the authors can convince me, see my comments regarding the Introduction and Conceptual Framework and Results).*

ANSWER: Mediation path-analysis in the framework of structural equation modeling is a widely adopted technique to test mediation hypotheses (e.g., Kline, 2015; Preacher, Rucker, & Hayes, 2007). In the Introduction section we aimed at further strengthening our argumentation for a mediation hypothesis.

RESULTS (Q5)

Referee: 1
Q5: *See Methodological comments.*

Referee: 2
Q5:
1. *The authors mention the Cronbach's alpha's, but do not elaborate on the possible effect of the below desirable reliability for the external motives.*

ANSWER: We agree about this concern. Accordingly, in the limitations we better specified that standardized measures of motivation may also be used to further validate the model we tested (cfr. p. 15). In addition, although a Cronbach's alpha equal to .60 could be considered the lowest acceptable value for this index of reliability, many still consider it as sufficient [Lance, C. E., Butts, M. M., & Michels, L. C. (2006). The sources of four commonly reported cutoff criteria: What did they really say?. Organizational research methods, 9(2), 202-220.]

2. *My understanding is that one cannot measure effects with SEM, one can only study associations, even though based on theory you would expect causality/certain directions (as they describe in relation to the cross-sectional nature of the study on page 12). The authors should adjust their language accordingly throughout the paper, as they often speak of effects, implying causality. For example, page 10, 11-16: deep learning approach mediated the 'association' (instead of effect) of internal motives on empathy, while surface learning approach medicated the 'association' of external motives on empathy.*

ANSWER: We could have tested real effects using SEM mediation path-analyses techniques only if measures were collected at different time points. We agree with the Referee that a major limitation of our paper is its cross-sectional design, therefore we made sure to fully address this issue among the limitations and to avoid statements in the text that would refer to causal relationships, such as 'predict' or 'affect'.

DISCUSSION AND CONCLUSIONS (Q6)

Referee: 1
Q6: *Do the conclusions really follow the mediation results? If learning style mediates*

motivations, then should action be change motivation rather than learning styles. See also direction of causality comments earlier.

ANSWER: We better rephrased this part in the Discussion section as follows:

"While motivational factors for studying medicine seem difficult to influence as they exist before entering medical school, learning approaches can be modified by educational programs and pedagogical interventions (Baeten et al., 2010; Dart et al., 2000). Further studies should focus on the impact of strategies to reinforce deep learning approaches early in medical students' careers, in order to favour the progressive assimilation of essential professional attitudes, including empathy." (p. 12)

Referee: 2
Q6:
1. *The authors do not currently elaborate on the possible influence of being in the pre-selection year on the findings. During this year, the stakes are high because their performance in this year will decide whether they can continue their medical training. As a result, students may experience that their participation in the study (and the answers to the questionnaires, because they were not anonymous) may influence their chances of continuing their medical training, even if this is not actually the case. This may have influenced the findings.*

ANSWER: We agree about this limitation as a possible source of bias in our results, therefore we have now clearly reported it among the limitations (cfr. p. 13).

2. *In line with my doubts about the hypothesized model, I wonder if they can conclude that influencing students' learning approach could promote student empathy (page 12).*

ANSWER: In addition to the comment reported above, regarding similar concerns raised by the Referee 1, we have now better argued in the Discussion section about the need for investing in students' learning approaches as a source to improve their empathy:

"[…] Rosenthal et al. (2011) suggested that educational programs where medical students are given the opportunity to share observations and reflect upon positive and negative role models can preserve empathy. On a related note, Charon (2001) highlighted the relevance of strengthening the role of deep learning approaches such as reflection and self-awareness in medical academic curricula as tools to practice medicine with more empathy." (pp. 11-12)

3. *I agree with the described limitations of the study. With regards to the conclusion, I think that it is too strong a statement to say that the study sheds light on protective and deteriorating factors for empathy (page 13)*

ANSWER: We agree that this statement was too strong given the correlational nature of our analyses. We rephrased this sentence at the end of the Discussion section as follow:

"[…] this study might contribute to the understanding of positive as well as negative psychological correlates of empathy among medical school candidates." (p. 13)

CLARITY, LENGTH AND ETHICAL APPROVAL (Q7)

Referee: 1
Q7: *Overall, this paper was quite difficult to read. Where possible, simpler constructions and words should be used. For example, while I can understand the meaning of "contraposition", it isn't in the 100,000 headword dictionary on my desk. "In contrast" or "whereas" would serve better. Overall the paper would benefit from shorter sentences, smaller words, and clearer explanations.*

Difficult to understand/incomplete sentences
1. *P3, L3, starting "Specifically" doesn't seem fully constructed.*
2. *P5. What do you mean by "contrasted transformation processes"?*

Typos
P7 – "comprehends" should be "comprises"?
P12 – "emphatic" should be "empathic"

ANSWER: We revised the paper according to style and grammar. We have also sent it out for a professional English proof-reading.

Referee: 2
Q7: *Overall, the manuscript is a nice read. However, the language should be improved. I advise the authors to have the manuscript checked and edited by a native English speaker. Ethical aspects have been addressed and ethical approval was applied for.*

ANSWER: Please see previous comment.