Investigating Emotions as a Mediator in the Transmission of Passion in Education

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Abstract

This cross-sectional research aimed to investigate a passion transmission model in the field of education as perceived by teachers and students. As per the Dualistic Model of Passion, the tested model posited that teachers' passion for teaching and the autonomy support they provide would influence students' passion for a discipline through the emotions displayed while teaching. In Study 1, a path analysis revealed that students (n=200) perceiving their teachers as passionate about teaching led to more positive and less negative emotions experienced in their classes. Moreover, positive emotions in the classroom were found to foster students' harmonious passion, while both positive and negative emotions were found to promote obsessive passion. Study 2 supported the proposed passion transmission model from the teachers' (n=208) perspective as well. The results mirrored those from Study 1, confirming that teachers' passion for teaching and the autonomy support provided to their students had an impact on their emotional experiences when teaching, thus influencing their perceptions of students' passion. Together, these two studies provide preliminary evidence for a passion transmission model in education and emphasize how teachers' passion and autonomy support collectively shape students' passion for a discipline through emotional experiences in the classroom.

Keywords Passion · Transmission · Emotions · Contagion · Students · Teachers

Most of us, at some point in our lives, have encountered or have heard stories from others who have encountered teachers who display not only their love and appreciation for the subject matter they are teaching but also have charisma when it comes to teaching in their disciplines. These educators demonstrate their enthusiasm for their job by instilling a genuine passion for learning, not just in academic areas but also in the broader sense, within their students. Given that previous educational research has shown positive outcomes for students who display passion for their studies in general (Vallerand et al., 2020; Sverdlik et al., 2022), or in a specific subject matter (e.g., mathematics, physics) (Bonneville-Roussy & Vallerand, 2020), understanding how passion unfolds in educational contexts is vital for fostering long-term engagement in learning.

The dualistic model of passion

Past research regarding passionate teachers has thus far shown how they consider themselves experts in their field, care for their students, have high levels of emotional intelligence, and promote the development of passion in their students by providing some degree of freedom and autonomy support (Mageau et al., 2009; Day, 2009). Other research in the work domain has also described passionate employers as being affective (Chen et al., 2020) and even how some entrepreneurs' passion can be transferred to their employees through the emotions they experience at work (Cardon et al., 2013; Li et al., 2017a, b).

In line with the *Dualistic Model of Passion* (DMP), passion can be described as a profound attraction towards an activity that defines us, one that we deeply cherish, value, and invest a significant amount of our time in (Liu et al., 2016). The DMP proposes that a loved activity either

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becomes an obsessive (OP) or a harmonious passion (HP) depending on whether its internalization in one's identity has been in an autonomous fashion or dependent on the constraints of external factors such as contingencies in the social environment). More specifically, when individuals autonomously internalize an activity, they recognize its importance without requiring conditions or prerequisites. Thus, they possess a profound inclination to participate in the activity they cherish while maintaining a harmonious equilibrium between it and other facets of their lives. These individuals experience a harmonious passion (HP) and live with it in a flexible way thus managing their time and energy to fully concentrate on alternate tasks when necessary. On the other hand, an activity can also be internalized in a more uncontrolled way whereby individuals will have more of a tendency to experience an obsessive passion (OP). In this case, individuals tend to persist rigidly in their passionate activity (i.e., they remain engaged despite deteriorating conditions) which often places strains on the other domains of one's life (Chichekian et al., 2022). In sum, individuals with HP can freely engage in their passionate activity and disengage when deemed appropriate, which is not the case for those who experience an OP.

According to research based on the DMP, students' affective experiences, academic behaviors, engagement, connections with others, performance, and study habits have all been examined as outcomes associated with experiencing passion in educational settings (Ruiz-Alfonso & León, 2016). Several studies have shown that, compared to OP, HP leads to more adaptive processes and outcomes such as openness to experience, adaptive emotion regulation strategies and challenge appraisals (Vallerand, 2015) in education (Saville et al., 2018). The DMP has mostly been useful in explaining research geared towards one's performance, in one's studies, or toward specific subjects like science (Chichekian et al., 2022). As such, passion is important for several outcomes and for all who play a role in education and significantly impact the development of students' passion for a given subjec (Vallerand et al., 2024).

The development of passion

The DMP suggests that the development of passion is influenced by three processes: activity selection (i.e., an individual's inclination or preference for a given activity over others), activity valuation (i.e., the activity's importance for the individual), and internalization (Vallerand, 2010). Consequently, the perception of having freely chosen an activity that aligns with their interests and identity is fertile ground for developing a passion for said activity. The intensity of this passion conveyed by the individual tends to increase with the level at which the activity is internalized (Schellenberg & Bailis,

2015). Similar to the Self-Determination Theory (SDT; Ryan & Deci, 2000), individuals typically participate in activities to fulfill three primary personal motives: (1) a longing to experience personal initiative (autonomy), (2) a yearning to engage proficiently with their surroundings (competence), and (3) a craving for a sense of connection with others or their surroundings (relatedness) (Donahue et al., 2009). In education, for example, high school students don't have much of a choice when it comes to studying specific school subjects; however, when they reach higher education, they do have some flexibility in choosing to pursue a discipline (e.g., physics, history, psychology) that they find enjoyable and that allows some degree of needs satisfaction regarding their competence, autonomy, and relatedness.

The development of passion can also take place over time with the presence of autonomy support as proposed by Ryan & Deci (2000). For example, when students who were registered for their first music class were provided with parental and teacher autonomy support early in the term, they developed HP and OP for music (Mageau et al., 2009). Athletes and students who interacted with autonomy-supportive parents and coaches also tended to display higher levels of passion (Halvari et al., 2009). Similar findings have also been found in work settings between employers and employees (Liu et al., 2011). Thus, it seems that autonomy support provided by adults exerts a notable influence on the development of learners' passion in a multitude of areas. It is noteworthy that while intrinsic motivation and passion both refer to loving an activity, passion is characterized by attributing importance to the activity and devoting a significant time commitment to it. In comparison with DMP, SDT suggests that intrinsically motivated activities find their existence in the transient space that is the person-task interaction and remains distinct from the person's identity (Koestner & Losier, 2002).

The role of passion and autonomy support

According to the DPMP, an individual's expressions of passions are not fixed or immutable, but rather dynamically influenced by their environment, allowing for the possibility of both HP and OP to develop depending on the impact of various determinants such as autonomy support. Autonomy support in education contexts refers to learning spaces in which students are encouraged, supported, and respected in making their own choices (Black & Deci, 2000; Ryan & Deci, 2017). Indeed, the level of decision-making support provided by key actors in the student's environment (e.g., parents, coaches, instructors) encourages autonomous internalization, which leads to the development of an HP (Schellenberg & Bailis, 2015). In contrast, the constraints of strict learning contexts, where individuals feel obligated to engage in tasks,

enable controlled internalization, which leads to the development of OP (Schellenberg & Bailis, 2015).

Despite studies revealing that most teachers still adopt a predominantly controlling attitude in their classrooms (Patall & Zambrano, 2019, by creating a positive link between autonomy, positive emotions (Oriol-Granado et al., 2017), and skills development, autonomous learning environments continuously prove to be spaces conducive to the development of passion in addition to other key student outcomes such as engagement, persistence (Patall et al. 2018), and autonomous self-regulation (Black & Deci, 2000) in students. To foster a learning environment that supports autonomy, teachers could emphasize the value of academic tasks while allowing students some freedom to explore what intrinsically motivates them (Cheon et al., 2020).

The role of emotions in passion

Affect encompasses all instances of sensation or sentiment, regardless of their degree of intricacy (VandenBos, 2007). This broad concept is often divided into two discrete dimensions: positive affect, which includes emotions such as excitement, and negative affect, which includes emotions such as irritation. It is an integral component of the concept and experience of passion, especially in the work domain (e.g., between supervisors and their employees, Cardon, 2008; Cardon et al., 2013; Ho & Astakhova, 2020). Affective processes have been considered central to both individual and group passion development (Cardon et al., 2017). For example, although entrepreneurs' passion had been found to influence employee's passion (Hubner et al., 2020), by having positive effects on employee's affective commitment (e.g., caring about the fate of an organization), such relations were mediated by other constructs such as positive emotions (Breugst et al., 2012). Consequently, when individuals are passionate about a given task, they experience certain emotions (e.g., enthusiasm), which are then transmitted to those with whom they are engaging (Parrisius et al., 2020). Cardon (2008) argued how this affective process mediated the transmission of passion at both team and individual levels, as experiencing passion in shared contexts would lead entrepreneurs to present their situational emotions, and such emotional displays would then inform similar emotional displays in others.

Research relying on the DMP has also investigated how people's affective experiences are associated with passion in educational settings (Ruiz-Alfonso & León, 2016). Similar to the work domain, educational contexts examining relationships such as teacher and students' transmission of emotions seem to stem from the person in a leadership position (Radel et al., 2010; Stebbings et al., 2016). Emotions such as enthusiasm are often associated with the transmission of

enjoyment from teachers to students and teachers who display high levels of enthusiasm for teaching can influence students' interest and motivation to learn (Frenzel et al., 2018; Parrisius et al., 2020). Similarly, students' perceptions of teachers' emotions (i.e., joy, anger, anxiety) while teaching were also related to students' emotions in specific subject domains (Becker et al., 2014).

Similarly, according to the DMP, passionate individuals' affective experiences are influenced by the degree of harmony or obsession with their passion. Research conducted with university students and athletes has provided support for this notion (Schellenberg et al., 2023). For instance, these studies concluded that when it comes to one's studies, having an HP is often conducive to positive affect and self-esteem. On the other hand, an OP towards studies is associated more with negative affect and negative psychological wellbeing. However, it is noteworthy that the relationship between affective experiences and passion is not always straightforward. In some cases, HP has a positive relationship with positive emotions and is either unrelated or negatively associated with negative emotions. Conversely, OP tends to have a slightly positive association with negative emotions and has a mixed relationship with positive emotions, either being unrelated or having a slightly positive association with them (Rahimi & Vallerand, 2021). In a meta-analysis conducted in the context of sports (Curran et al., 2015), positive emotions such as enjoyment and happiness were significantly related to both HP and OP for the sport; however, the relative affective balance was more positive for HP than OP. These findings suggest that the role of emotions does have an effect on how passion is perceived in various contexts, including education, and that positive emotions may be significant in the development of a healthy and balanced form of passion.

Passion and the emotional contagion

It is inevitable that with any social interaction, whether at work, at school, or while playing sports, there will always be some level of emotional exposure (Smith & Rose, 2020). Generally, mimicry of emotional states takes place between individuals either through facial, vocal, or postural expression (Hatfield et al., 1994; Prochazkova & Kret, 2017). For example, observing emotional expressions from others (e.g., through facial expressions; Ekman 1992) during a class exam may influence the way students experience their own emotions (Gross & Barrett, 2011). Similarly, research from the work domain has shown that passionate entrepreneurs' affective experiences at work influence the direction, intensity, and persistence of their employees' behavior too (Seo et al., 2004). Specifically, Cardon (2008) proposed that entrepreneurs' emotional mimicry is an important factor in the transmission of passion.

Some studies have also shown that teachers who are enthusiastic in the classroom positively affect their students' interest and motivation (Patrick et al., 2000). This mechanism is referred to as emotional contagion and is experienced in different contexts and various types of interactions, such as during TV commercials, teamwork, and human-robot or human-computer interactions (Chen and Ellsworth, 2019; Li et al., 2017a, b; Mindeguia et al., 2021; Wergin et al., 2018). Although examining only specific types of emotions (i.e., enthusiasm) may be more informative of nuanced information about an individual's affective state, they may also have different implications depending on their context and frequency. For example, the frequency of positive or negative emotions may differ depending on the classroom climate or learning environment (e.g., online classes with deactivated video). These contextual details in education, and especially in performance-based environments (e.g., competitive sports) can activate various types of emotions.

Based on the above and drawing from the emotional contagion literature, the main purpose of the current research was to empirically test a mediation model in education (Frenzel et al., 2018), similar to that within the entrepreneurial context (i.e., from entrepreneurs to employees), wherein the potential transmission of passion is explored from teachers to students through positive and negative emotions as a whole.

The present research

The current research proposes to test a model regarding the potential emotional contagion of passion in education.

There were three goals to this research. First, the emotional contagion process in the PTM would be explored by considering teachers' passion for teaching and their autonomy-supportive teaching style which, in turn, were expected to generate positive emotions and protect against negative emotions. Based on their unique instructional styles, teachers may provide varying levels of autonomy support to their students, which also helps create a positive classroom environment conducive to positive emotions (Stebbings et al., 2015).

A second goal was to empirically examine the outcome of the emotional contagion process and, specifically, the extent to which emotions had an impact on students' OP and HP for the discipline. Research has shown that individuals not only experience emotions when they engage in their passionate activity (Vallerand et al., 2003), but that such emotions are also displayed and picked up by those who also participate in the activity (Philippe et al., 2010). In educational contexts, this would translate into teachers displaying both types of emotions which are then picked up by students.

The third and final objective was to explore the associations between students' emotions and their passion. According to past research, positive emotions were to be linked to both types of passion, while negative emotions were to be linked solely to OP (Vallerand, 2015).

The PTM was tested across two cross-sectional studies: Study 1-- from the perspective of teachers and Study 2 -- from the perspective of students. Participants from both studies were recruited from Prolific. Unlike Amazon Mechanical Turk (Chmielewski & Kucker, 2020) which is a popular platform for businesses and researchers who need large volumes of simple tasks completed quickly and at low cost, the Prolific platform (Peer et al., 2022) is an online marketplace geared more toward academic research studies. Prolific aims to provide a more efficient and ethical way for researchers to recruit participants for their studies through surveys, experiments, or user testing, while also providing payment that is typically higher than on other similar platforms, to incentivize high-quality responses (Palan and Schitter, 2017; Peer et al., 2017). Prolific provides a pool of pre-screened participants who have opted in to be part of the platform and meet certain criteria, such as age, gender, and profession. Participants can sign up for Prolific and browse available studies that match their demographics and interests. They can then choose to participate in studies that they are eligible for and interested in. Prolific also places a strong emphasis on ethical research practices, such as informed consent, fair payment, and transparency. Researchers are required to adhere to strict guidelines regarding their study design and participant interactions and participants have the option to report any issues with a study or researcher to Prolific's support team.

In general, Prolific has been shown to provide platform-level precautions for producing high-quality data (Peer et al., 2022). For example, when creating an account on the Prolific platform, users are required to submit their unique email, phone number, and PayPal account, which are verified. This, combined with blocking suspect IP addresses are tactics to prevent the creation of duplicate or bot accounts.

Study 1

In Study 1, the PTM posited that teachers' autonomy support and passion for teaching would be associated with their emotions while teaching which, in turn, would be predictive of their perceptions of regarding their students' passion for a specific subject. Based on findings from entrepreneurial passion and its transference through emotions from employers to employees (Cardon, 2008; Cardon et al., 2017), it was expected that teachers' passion for teaching and their autonomy support would influence their emotions while teaching. It was further hypothesized that teachers' emotions would

also be related to their perceptions of their students' HP and OP (Fig. 1).

Method

Participants

Participants were 208 teachers (73 males and 135 females) recruited through Prolific. Participant's employment as a teacher was established using the Prolific platform pre-screening questions and confirmed by a question in the survey (e.g., "You indicated that you worked in the education industry. Does your job involve teaching?). Participation in this study was entirely voluntary and all participants provided informed consent before data collection. Participants ranged in age from 18 to 72 years old ($M = 34.04$, $SD = 10.36$), including new (1-5 years of experience, 39.9%) and more experienced teachers (10+ years of experience, 28.4%). Teachers were mostly residents of the United Kingdom (35%), the United States (7.8%), Spain (8.3%), Portugal (6.8%), and Greece (6.8%), and were teaching full-time (64.3%) and part-time (35.3%). They were from different school levels, namely from primary (39.9%), high school (24%), college (9.6%), and university 19.3% (undergraduate 13.5% and graduate 5.8%).

Teachers were asked to think about a course they love to teach, and the number of times taught in the last two years. This timeframe was chosen to mitigate its effects on the variables (Watson et al., 1988) while providing more options for participants who teach courses spanning the entire school year. The most common courses were Mathematics ($n = 32$), English ($n = 37$), and History ($n = 18$). Teachers indicated having taught the selected course once ($n = 23$), twice ($n = 83$), three times ($n = 38$), or four times ($n = 58$). 62.5% of teachers indicated that they were currently teaching this course right now. Data from participants failing the survey's two attention checks (e.g., "It's important that you pay attention to this study. Please tick 'do not agree at all'.") were removed.

Measures

All survey measures used a Likert-type scale ranging from 1 (*do not agree at all*) to 7 (*absolutely agree*) unless otherwise indicated. Teachers were asked to think about how they taught the course they enjoyed teaching and respond to the scales below. The number of times teachers had taught the course was taken into consideration during the path analysis.

Teachers' perceptions of autonomy support (α = .84, McDonald's Omega = .84) Teachers' perceptions of their provided autonomy support were measured using five items derived from the *Learning Climate Questionnaire* (Black & Deci, 2000; "I provide my students with choices and options for their project(s) or assignment(s)").

Teachers' passion for teaching (α = .77, McDonald's Omega = .79) Teachers' passion for teaching was measured using three modified items derived from *Passion for founding*, one of the three subscales in the Entrepreneurial Passion Scale (Cardon et al., 2009). *Passion for founding* for entrepreneurs has been an important motivator in organizations as it relates to a role identity that is central to one's self-concept. As such, this subscale was adapted to the teaching context to measure the extent to which teachers experience passion for their profession primarily by enjoying the process of teaching. The three items used for this scale were: "I am really pleased about my teaching profession", "I feel energetic when talking about my subject in class", and "I enjoy cultivating my students' interests."

Teachers' emotions Teachers' positive and negative emotions were assessed using ten items drawn from the short version of the Positive and Negative Affect Schedule (PANAS, Mackinnon et al., 1999; Watson, et al., 1988), including five items that measure positive emotions (e.g., "enthusiastic", α = .73, McDonald's Omega = .76) and five items measuring negative emotions (e.g., "distressed," α = .77, McDonald's Omega = .79).

Teachers' perceptions of their students' passion Teachers' perceptions of their students' passion were measured using six items drawn from the Passion Scale (Vallerand et al., 2003), with three items measuring HP (e.g., "The subject of this course is in harmony with other interests my students have," α = .70, McDonald's Omega = .70) and three items measuring OP (e.g., "My students have difficulties disengaging from the subject of this course," α = .81, McDonald's Omega = .84). These three items were selected instead of the original six items because they were deemed to be the ones that teachers would most likely be able to observe in class. Results from confirmatory factor analyses supported the two-factor structure of the Passion Scale, (χ^2/df) = 0.394, TLI = 1.025, CFI = 1.000, RMSEA = 0.000, SRMR = 0.0013.

Thus far, the scale operationalization of the DMP framework has been successfully validated in different languages (Cid et al., 2019), shown to be largely invariant for gender, language, culture, type of activities (Vallerand et al., 2020), and has shown high levels of internal consistency, as well as predictive, discriminant, construct, and external evidence of validity (Castelda et al., 2007; MacKillop et al., 2006; Stenseng, 2008).

Data analysis

Data were analyzed using SPSS and R (version 3.6). The means, standard deviations, and correlations for all variables are presented in Table 1. To test the proposed model, a path analysis was conducted with Maximum Likelihood, using bootstrapping (5000 samples, with 95% bias-corrected confidence intervals [CI's]). Given this was the first time teachers' and students' passions were being assessed in the same model, path analysis was used instead of structural equation modeling. To assess the goodness-of-fit for the proposed model, absolute and incremental fit indices were observed including the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), the Standardized Root Mean Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA). A CFI and TLI score above .97 and SRMR and RMSEA score below .06 would demonstrate a very good fit for a model.

Results

Results of the path analysis revealed an excellent fit to the data, χ^2 (df = 8) = 10.687, p = .989, CFI = .993, TLI = .981, SRMR = .040, and RMSEA = .040 [.000; .097]). Overall, the study's hypotheses were supported in their majority. Teachers' perceptions of autonomy support (β = .31, p < .001) were positively related to their positive emotions when teaching, whereas teachers' passion for teaching was positively related to their positive emotions (β = .42, p < .001) and negatively related to their negative emotions (β = -.31, p < .001). Additionally, teachers' positive emotions were positively related to their perceptions of students' HP and OP (β = .31, p < .001, β = .24, p = .001, respectively), whereas their negative emotions were positively related to their perceptions of students' OP (β = .15, p = .025). Finally, teachers' perceptions of autonomy support and their passion for teaching were directly related to students' HP (β = .26, p = .001, β = .14, p = .05, respectively) (see Fig. 2). Standardized results showed four significant indirect paths in which teachers' positive emotions mediated the relationships between both teachers' perceptions of autonomy support and teachers' passion with their perceptions of students' HP and OP (see Table 2). The indirect path from teachers' passion for teaching to students' OP was not significantly mediated by negative emotions.

In sum, passion for teaching led to more positive and less negative emotions, which in turn promoted teachers' perceptions of their students' HP. As expected, extrapolating from the relationships between coaches and their athletes in the sports domain (Stebbings et al., 2016), teachers' autonomy support was only associated with positive emotions. Both positive and negative emotions fostered teachers' perceptions of students' OP. In addition, teachers' autonomy support and passion for teaching were positively associated with perceptions of students' HP. Taken together, the findings

Table 1 Means, Standard Deviations, and Correlations for Study 1(Teachers' perspective)

	M	SD	α	1	2	3	4	5	6	7
1. Number of times taught the course	3.15	3.01	–	1						
2. Teachers' autonomy support	5.83	0.93	.83	.11	1					
3. Teachers' passion for teaching	5.82	0.89	.78	.08	.58***	1				
4. Teachers' positive emotions when teaching	5.48	0.79	.71	.07*	.56***	.59***	1			
5. Teachers' negative emotions when teaching	2.52	0.95	.79	-.05*	-.27***	-.30***	-.20**	1		
6. Teachers' perceptions of students' HP	5.06	1.81	.77	.01*	.53***	.51***	.54***	-.21**	1	
7. Teachers' perceptions of students' OP	3.28	1.42	.76	-.09	.11	.18**	.20**	.05	.45***	1

HP = Harmonious passion, *OP* = Obsessive passion

*p < .05. **p < .01. ***p < .001.

Fig. 1 Hypothesized Passion Transmission Model
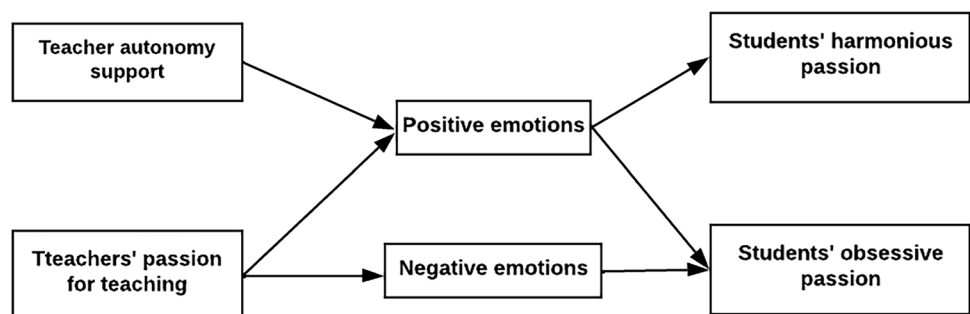
provide some evidence for the PTM in the context of education from the perspective of teachers.

Alternative mediation models

Given Cardon's (2008) proposal regarding the important role of emotional mimicry and positive emotions in the transmission of passion, alternative mediation models were tested to determine whether they fared better than the proposed model in Study 1. Research in educational settings has demonstrated that positive emotions characterize a good teacher and facilitate the transmission of such emotions from teachers to students during classroom instruction (Frenzel et al., 2018; Kunter et al., 2008; Pekrun, 2006). To test if positive and negative emotions generated

the best model fit indices, thus rendering our proposed model the one that best facilitated the transmission of passion, five alternative models were tested: one model in which positive and negative emotions were mediators but their perceptions of students' passion were identified as the predictors instead of the outcomes, two models in which teachers' autonomy support and passion for teaching acted as mediators, and two other models in which teachers' perceptions of students' OP and HP played the role of mediator. The results indicated that the fit indices of the proposed model in Study 1 fared better than all the alternative ones (see Table 3). Overall, these findings revealed that teachers' autonomy support and passion for teaching appear to facilitate the transmission of both OP and HP through positive and negative emotions while teaching.

Fig. 2 Path Analysis from The Perspective of Teachers (Study 1). *p < .05. **p < .01, ***p < .001
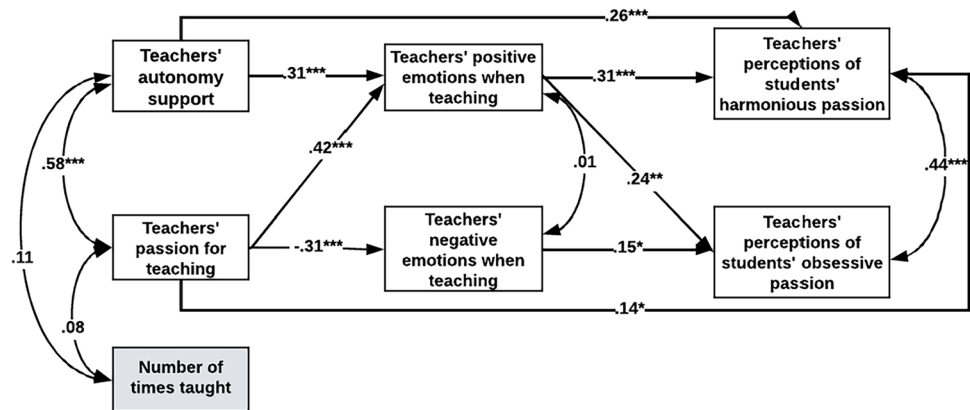
Table 2 Indirect Effects of Emotions in Study 1(Teachers' perspective)

Predictor	Mediator	Outcome	β	95% CI	p-value
Teachers' autonomy support	Teachers' positive emotions when teaching	Teachers' perceptions of students' HP	.10	[.33, .19]	p =.005
Teachers' autonomy support	Teachers' positive emotions when teaching	Teachers' perceptions of students' OP	.07	[.03, .20]	p =.006
Teachers' passion for teaching	Teachers' positive emotions when teaching	Teachers' perceptions of students' HP	.13	[.06, .25]	p =.002
Teachers' passion for teaching	Teachers' positive emotions when teaching	Teachers' perceptions of students' OP	.10	[.04, .28]	p =.007
Teachers' passion for teaching	Teachers' negative emotions when teaching	Teachers' perceptions of students' OP	-.05	[-.15, -.01]	p = .041

HP = Harmonious passion, *OP* = Obsessive passion.

Table 3 Fit Indices of Alternative Mediation Models for Study 1 (Teachers' perspective)

Predictors	Mediators	Outcomes	CFI	TLI	RMSEA	SRMR
TPT-TAS	TPA-TNA	PSHP-PSOP	0.992	0.981	0.041	0.040
TPT-TAS	PSHP-PSOP	TPA-TNA	0.979	0.897	0.110	0.049
PSHP-PSOP	TPA-TNA	TPT-TAS	0.978	0.834	0.140	0.039
PSHP-PSOP	TPT-TAS	TPA-TNA	0.983	0.874	0.121	0.039
TPA-TNA	PSHP-PSOP	TPT-TAS	0.980	0.913	0.101	0.038
TPA-TNA	TPT-TAS	PSHP-PSOP	0.984	0.940	0.084	0.033

TPT = Teachers' Passion for Teaching, *TAS* = Teacher Autonomy Support, *TPA* = Teacher Positive Affect, *TNA* = Teacher Negative Affect, *PSHP* = Perceptions of Students' Harmonious Passion, *PSOP* = Perceptions of Students' Obsessive Passion.

Study 2

In Study 2, students were asked to think of a course they loved, write down the name of this course (e.g., Biology, Chemistry, Geography), and when they had taken it (i.e., "How long ago did you follow this course?"). To ensure students selected a course they were passionate about, participants were free to choose a past or a current course. The most frequent course selections were in mathematics ($n = 14$), psychology ($n = 13$), and biology ($n = 10$). Approximately 50% of the sample indicated being currently enrolled in this course and the other half had selected a course they had taken in the last five years.

Similar to Study 1, it was expected that students' perceptions of their teachers' passion for teaching and their autonomy support would be influenced by the emotions they felt in class while learning about the subject of their favorite course. Additionally, it was expected that students' emotions would also impact their HP and OP for their favorite course.

Method

Participants

Participants were 200 students (122 males and 78 females) recruited through Prolific. Student status was established using the platform's pre-screening questions and confirmed with a demographic question about their current education level. This question could only be answered by a user who had indicated being a current student. Participants ranged in age from 18 to 26 years old ($M = 18.46$, $SD = .763$). Participants resided in the United Kingdom (35.5%), Poland (18%), Portugal (14.5%), United States (11.5%), and other countries and were currently enrolled in a science program (26%), engineering (17%), social studies (9.5%), among other programs (e.g., law, arts, etc.). Their education level was a high-school diploma (42.5%), Undergraduate Degree (29%), Technical/Community College (12.5%), Secondary education (7%), and Graduate Degree (6.5%) among others. Participation in this study was entirely voluntary and all participants provided informed consent before starting.

Participants were deemed to have provided low-quality data and were automatically excluded if they could not remember a course they loved or a course they disliked or failed the survey's two fair attention checks (e.g., "Please select scale point six.").

Measures

All survey measures were on Likert-type scales ranging from 1 (*do not agree at all*) to 7 (*absolutely agree*) unless otherwise indicated.

Students' perceptions of teacher autonomy support (α = .83, McDonald's Omega = .84) Students were asked to think about the teacher in their selected course and respond to five items from the Learning Climate Questionnaire measuring perceived autonomy support (Black & Deci, 2000, e.g., "My teacher provided me with choices and options").

Students' perceptions of their teacher's passion (α = .78, McDonald's Omega = .79) Students were asked to think about the teacher in their selected course and self-report their perceptions regarding their teacher's passion for teaching. The same three items were used from Study 1 that were derived and modified from the Entrepreneurial Passion Scale (Cardon et al., 2013): "My teacher really seems pleased about his/her profession", "My teacher is energetic when talking about his/her subject", and "My teacher enjoys cultivating his/her students' interests."

Students' emotions Students were asked to indicate to what extent they felt positive and negative emotions while taking classes in their selected course. Positive and negative emotions were measured using the short version of the Positive and Negative Affect Schedule (PANAS; Mackinnon et al., 1999; Watson et al., 1988), consisting of five items measuring positive affect (e.g., "enthusiastic," α = .71, McDonald's Omega = .72) and five items measuring negative affect (e.g., "upset," α = .79, McDonald's Omega = .79).

Students' passion The Passion Scale (Vallerand et al., 2003) was used to assess students' passion for the topic in their favorite course. The scale consisted of six items measuring HP (e.g., "This subject is in harmony with other things that are part of me," α = .77, McDonald's Omega = .78) and six items measuring OP (e.g., "This subject is the only thing that really stimulates me." α = .76, McDonald's Omega = .77). The two-factor model showed adequate fit for the scale's internal structure, (χ^2 / df) = 1.92, TLI = 0.902, CFI = 0.930, RMSEA = 0.068, SRMR = 0.0058.

Results

Data were analyzed using the same statistical software and analysis methods as in Study 1. The means, standard deviations, and correlations for all variables are presented in Table 4.

Results of the path analysis revealed an excellent fit to the data, χ^2 (df = 6) = 4.433, $p = 0.618$, CFI = 1.000, TLI = 1.021, SRMR = .034, and RMSEA = .000 [.000; .081]). Students' perceptions of their teacher's autonomy support were positively related to their positive emotions ($\beta = .20$, $p = .004$), whereas students' perceptions of their teacher's

passion for teaching were positively related to students' positive emotions (β = .22, p = .005) and negatively related to students' negative emotions (β = -.27, p < .001). In turn, students' positive emotions were positively related to students' HP and OP (β = .41, p < .001, β = .33, p < .001, respectively), and students' negative emotions in class were also positively related to their OP (β = .28, p < .001, see Fig. 3).

Indirect effects were investigated showing statistically significant results as indicated by 1) the p values and 2) not passing 0 in the upper and lower limits for the bias-corrected 95% bootstrapped confidence intervals. Standardized results indicated that students' positive emotions mediated the relationship between both students' perceptions of teacher autonomy support and their teachers' passion with students' HP and OP. The indirect path from teachers' passion to students' OP was also mediated by students' negative emotions (see Table 5).

Overall, these findings provide support for the PTM from the students' perspective. The results of Study 2 showed that when students perceive that their autonomy is being supported by their teachers and when they perceive that their teachers are passionate about teaching, students experience more positive, less negative, emotions in class. While positive emotions promote students' HP, both positive and negative emotions promote students' OP.

Alternative models

Five alternative mediation models were also tested from the students' perspectives to assess the extent to which positive and negative emotions as a whole generated better model fit indices for a model of transmission of passion compared to other mediators: one model in which students' positive and negative emotions were mediators but their OP and HP were identified as the predictors instead of the outcomes,

Table 4 Means, Standard Deviations, and Correlations for Study 2 (Students' perspective)

	M	SD	α	1	2	3	4	5
1. Students' perceptions of teacher autonomy support	5.84	0.92	.84	1				
2. Students' perceptions of teachers' passion for teaching	5.83	0.90	.77	.59***	1			
3. Students' positive emotions when in class	5.50	0.78	.73	.58***	.58***	1		
4. Students' negative emotions when in class	2.51	0.94	.77	-.26***	-.29***	-.19**	1	
5. Students' HP	5.06	1.04	.69	.56***	.53***	.56***	-.17*	1
6. Students' OP	3.28	1.41	.81	.10	.19**	.21**	.10	.44***

HP = Harmonious passion, OP = Obsessive passion

*p < .05. **p < .01. ***p < .001.

Fig. 3 Path Analysis from The Perspective of Students (Study 2). *p < .05, **p < .01, ***p < .001
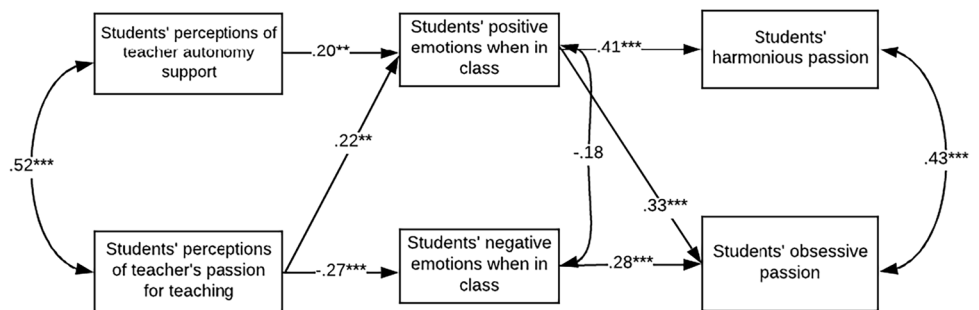
Table 5 Indirect Effects of Emotions in Study 2 (Students' perspective)

Predictor	Mediator	Outcome	β	95% CI	p-value
Students' perceptions of teacher autonomy support	Students' positive emotions when in class	Students' HP	.08	[.01, .12]	p = .015
Students' perceptions of teacher autonomy support	Students' positive emotions when in class	Students' OP	.07	[.02, .13]	p = .010
Students' perceptions of teachers' passion for teaching	Students' positive emotions when in class	Students' HP	.09	[.02, .14]	p = .011
Students' perceptions of teachers' passion for teaching	Students' positive emotions when in class	Students' OP	.07	[.01, .16]	p = .019
Students' perceptions of teachers' passion for teaching	Students' negative emotions when in class	Students' OP	-.08	[-.15, -.03]	p = .003

HP = Harmonious passion, OP = Obsessive passion.

two models in which students' perceptions of their teachers' autonomy support and passion for teaching acted as mediators, and two other models in which students' OP and HP played the role of mediator. The results indicated that the fit indices of the proposed model in Study 2 fared better than all the alternative ones (see Table 6), thus rendering our proposed model the one that best facilitated the transmission of passion from the students' perspective. Overall, these findings revealed that students' perceptions of teachers' autonomy support and passion for teaching appear to facilitate the transmission of both OP and HP through positive and negative emotions.

General discussion

The primary goal of the current study was to propose and empirically test a potential model for the transmission of passion in educational settings with students and teachers. The model posits that teachers' passion for teaching as well as their autonomy-supportive teaching style is conducive to positive emotions (and protects against negative emotions). Furthermore, when one's autonomy is supported, emotions experienced while engaging in a given subject are internalized over time into one's identity, thus increasing the likelihood of developing a passion for the subject. The PTM model as hypothesized was supported in two studies, taking the teachers' perspective in Study 1 and that of the students in Study 2. In both studies, positive emotions led to the development of HP, whereas both types of emotions were associated with OP. While participants reported experiencing negative and positive emotions (i.e., mixed emotions, see Larsen et al., 2017), we did not assess the concurrent occurrence of these emotions. Although in both studies positive and negative emotions were significantly correlated, the degree to which they co-occur is a different dimension of the link between the two constructs. Past studies (Roseman, 2017) have demonstrated how mixed emotions play an important role in passion, specifically through intense emotions that emerge during transformative events such as

political activism or betrayals. In the latter, passion seems to be related to positive and to negative emotions; however, in the context of the present research, although HP and OP were mediated by both types of emotions, we cannot conclude that a co-occurrence has taken place within individuals or with peers. These findings have several implications and lead to some suggestions for future research avenues.

Support for the passion transmission model

The first implication of the present research is that teachers' passion appears to be transmissible to students, providing preliminary evidence for the PTM. Supporting previous research in which passion has been transmitted from employers to employees (Breu and Yasseri, 2023; Hubner et al., 2020; Li et al., 2017a, b), the present studies suggest that teachers also have the potential to transmit their passion to their students. As such, teachers' passion could assume the role of an antecedent of students' passion when examined from both students' and teachers' perspectives. Thus, in line with past studies, passion appears to also be "contagious" in educational settings (Gilal et al., 2019; Liu et al., 2011). In addition, the study's findings are similar to those obtained by Mageau et al. (2009) showing that autonomy support provided to students by teachers helps to promote the development of students' passion. Furthermore, in Study 1 (teachers' perspective), teachers' perceptions of their autonomy support and passion were *directly* related to perceiving HP in their students. These findings suggest that other mediators between teachers' and students' passion may exist.

Relatedly, a second implication of the present research is the examination of the PTM from both the perspectives of students and teachers. Although one-sided views of the transmission process (e.g., students' perceptions) have been examined in previous research (Tóth-Király et al., 2021), far less research has looked at both perspectives (Parrisius et al., 2020), thus limiting the current understanding of the passion transmission process given that the experiences of students and teachers could be vastly different. This dual-perspective

Table 6 Fit Indices of Alternative Mediation Models for Study 2 (Students' perspective)

Predictors	Mediators	Outcomes	CFI	TLI	RMSEA	SRMR
PTPT-PTAS	SPA-SNA	SHP-SOP	1.000	1.021	0.000	0.034
PTPT-PTAS	SHP-SOP	SPA-SNA	0.901	0.751	0.130	0.084
SHP-SOP	SPA-SNA	PTPT-PTAS	0.910	0.807	0.115	0.098
SHP-SOP	PTPT-PTAS	SPA-SNA	0.946	0.839	0.105	0.062
SPA-SNA	SHP-SOP	PTPT-PTAS	0.893	0.733	0.136	0.095
SPA-SNA	PTPT-PTAS	SHP-SOP	0.906	0.646	0.156	0.078

PTPT = Perceptions of Teachers' Passion for Teaching, *PTAS* = Perceptions of Teachers' Autonomy Support, *SPA* = Student Positive Affect, *SNA* = Student Negative Affect, *SHP* = Student Harmonious Passion, *SOP* = Student Obsessive Passion.

approach allows for more precise conclusions to be drawn when looking at similarities and possible differences between each viewpoint. Having both perspectives in the present paper provides additional validity for the PTM, given that the same pattern of results emerged in the two studies.

The mediating role of emotions

A third and final implication is that emotions were found to mediate the transmission of passion between teachers and students, providing support and extending past findings regarding entrepreneurial passion (Cardon et al., 2013; Hubner et al., 2020). When teachers are passionate, they tend to feel and display positive emotions and their students are more likely to perceive them and experience such feelings as well (Gilal et al., 2019). In both studies, four significant indirect paths were found wherein positive emotions mediated the relationships between both perceptions of autonomy support and teachers' passion with students' HP and OP. One explanation for why positive emotions can contribute to the transmission of both OP and HP is because passion, in general, is an intense and emotionally charged motivational state that is associated with positive feelings. When we feel passionate about something, we experience a range of intense emotions such as excitement, joy, and happiness. In the case of OP, positive emotions can drive an individual's intense focus on a particular activity (Dalpé et al., 2019). In an education context, a high-energy and dynamic teaching style can create a highly activated learning environment (Frenzel et al., 2021), thus increasing students' excitement toward an activity to the point that it may become uncontrollable, thereby leaning more toward an OP (Waaler et al., 2022). In sports, for example, an individual who is obsessively passionate about a sport may experience intense positive emotions such as excitement and joy when they are engaged in the activity (Schellenberg et al., 2021). However, these same positive emotions can also contribute to the development of an unhealthy level of attachment or dependence on the activity, leading to more compulsive behavior and negative psychological well-being (Holding et al., 2021). This is not the case with HP, wherein positive emotions can contribute to a more healthy and balanced form of passion, rather than one based on dependency or external validation. Overall, while positive emotions can contribute to both OP and HP, the key difference lies in the relative balance which is much more positive for HP than for OP.

As far as testing the potential of the emotional contagion model, one explanation is that positive emotions such as enthusiasm and excitement are conveyed through different means of communication such as tone of voice, facial expressions, and especially body language. In a classroom, teachers tend to be more animated and expressive while trying to make the material come alive, either by using real-life

examples or hands-on activities, which makes the learning process more enjoyable for students as well. Given that these positive emotions seem to be related to high activation (Parrisius et al., 2020), it was not surprising that they mediated the relationship between teacher's passion for teaching and autonomy support with students' passion; however, this model will still need to be tested in different learning environments such as face-to-face, blended, hybrid, and online.

Additionally, considering the nuances in contextual parameters, students who are passionate about what is being taught and are eager to learn don't necessarily have the opportunity to display emotions in class, especially if they are in a relatively passive state compared to the teacher. For example, aside from actively participating in discussions, asking thoughtful questions, and contributing to group activities, students have limited opportunities to display positive emotions in class. Moreover, while participating in an active-learning classroom is easier to recall (Bucklin et al., 2021; Finkelstein & Winer, 2020), other indicators of positive body language or nonverbal cues such as sitting up straight and leaning forward (i.e., signs that one is interested and engaged) are not cues that one is likely to remember, especially if the course had taken place some time ago. In the same vein, it is also possible that the role of negative emotions was masked or not fully visible given that the display is dependent on the type of approach such as an avoidance behavior (Rowe & Fitness, 2018). However, the exploratory approach to the current study is a beginning step toward more controlled or experimental research that might provide a clearer understanding of the mediating role of emotions during a passion transmission process in academic settings.

Of additional interest is the fact that whereas emotions were found to serve as mediators between teachers' passion to their students' passion in both studies, the results of Study 1 also showed that teachers' passion was transmitted directly to their students' HP. This last finding suggests that the two perspectives may not be fully equivalent, and that teachers' passion may be mediated by other variables. Most of the previous research has only considered positive emotions (and sometimes only one such as enjoyment; Frenzel et al., 2018) as mediator in the classroom. Perhaps encouragement, life lessons, corrective feedback, and other adaptive verbal messages provided by teachers may also be involved in the transmission of passion (Carpentier & Mageau, 2016).

Overall, the present results highlight the critical role that emotions (both those of students and teachers) could potentially play in the transmission process and guide future research (e.g., the use of interventions to promote positive emotions in both populations). These findings also replicate and extend previous research on the DMP showing HP to be more strongly related to positive emotions and OP to be more strongly related to negative emotions (Rahimi et al., 2021).

Limitations and future research

Findings from this present research should be interpreted with caution due to some limitations. First, as mentioned previously, other variables could also mediate the association between teachers' and students' passion. Thus, future research should examine other potential mediators such as teachers' feedback. Second, a cross-sectional design was used and thus no causal inferences can be drawn from cross-sectional research designs using mediational models. Given that the mediator is thought to explain the process or mechanism by which an IV influences the DV, mediation models usually assume a causal chain, in which the IV affects the mediator, which in turn affects the DV. In both studies, data were collected at a single point in time, and there was no manipulation of variables or control of extraneous variables. Therefore, it was not possible to establish temporal precedence nor rule out alternative explanations for the relationship between the variables. Despite these limitations, results from these two studies can still be informative and provide useful insights into the relationships between variables, especially if there is theoretical justification. In this case, our models were theoretically driven based on the DMP (Vallerand, 2015), as well as similar ones that were tested in research by Cardon and colleagues (2008) using the literature on emotional contagion (Gilal et al., 2019). Finally, because positive and negative emotions were associated with both the IV and the DV, the results can also be used to generate hypotheses and lead to the formulation of new questions for future research. Experimental and longitudinal designs are also encouraged to replicate the present findings and show how students' passion evolves.

Overall, the present research has practical implications and offers avenues for future research. For instance, given the important role that teachers' passion plays in the PTM, promoting teachers' passion for teaching is encouraged. More specifically, teachers could be trained on how to be more passionate about their professions through strength-based interventions promoting passion (Dubreuil et al., 2016; Ho et al., 2018) and adopting strategies to cultivate passion in the classroom (Chen et al., 2021). Alongside their passion, teachers' positive emotions should also be elevated through learning opportunities such as workshops on emotional regulation techniques, to promote positive emotions and reduce negative ones in classroom settings or among colleagues. In addition, given that autonomy-supportive environments promote teachers' and students' positive emotions and students' HP, teachers are encouraged to learn how to create such environments with the help of institutional support. More specifically, teachers could include opportunities for students to make choices in pedagogical materials, such as choosing a topic for an assignment, while fostering a healthy learning environment in which students feel supported in exercising their free will. These results pave the way for interesting future research into the transmission of passion, either by solidifying the role of emotional contagion in interpersonal interactions to better understand behavioral synchronization or by deconstructing emotional contagion through human-robot interactions.

In sum, findings from these studies provide empirical support for the PTM from students' and teachers' perspectives. Emotions facilitated the transmission of passion between teachers and students in both studies. While positive emotions promoted students' HP and to a lesser extent their OP, negative emotions promoted only students' OP. Additional research is required to replicate the PTM with different mediators, methodological approaches, and populations, as well as uncover the nuances of these interactions to gain a better understanding of the experiences of co-occurring emotions in learning environments.

The contagion of teachers' passion to students is an area of uncharted territory that leaves us with more questions than answers. If the ability to influence the emotional climate of a classroom can have a long-lasting impact on students' attitudes, then the challenge for future research is to find solid empirical evidence to improve upon this proposed passion transmission process.

Declarations

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