



## Research paper

## Teachers' engaging messages: The role of perceived autonomy, competence and relatedness

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## HIGHLIGHTS

- Teachers can be classified according to their communicative style.
- Most teachers use gain-framed messages and self-determined motivational appeals.
- Teachers' basic needs is related with teachers' communicative style.
- Teachers' communicative style is related with students' academic performance.
- Data adds to the insight of the link among teacher inner and outer side.

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## ABSTRACT

"If you work hard you will learn interesting facts". "Unless you work hard you will get into trouble". These are examples of engaging messages teachers use to encourage engagement among their students. These kind of messages have been recently addressed by researchers, yet the reason why teachers use certain messages remains unexplored. This study aimed to identify profiles of teachers' engaging messages and how these relate to their basic needs and students' performance. The sample comprised 48 teachers and 1150 students. At the student-level, latent profile analysis showed three profiles: the gain-framed messages (GFM), the few-messages (FM), and the all-messages (AM) profiles. At the teacher-level, multilevel profile analysis showed an active and a passive profile. Results also indicated that teachers' basic psychological needs were related to their use of engaging messages and this was related to students' performance.

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Teachers play an essential role in students' learning, motivation, academic performance, and well-being (Bartholomew et al., 2018; Blazar & Kraft, 2017; Collie & Martin, 2017; Hill et al., 2019; Lazarides et al., 2019; León et al., 2017; Sevil et al., 2017). Amongst the strongest promoters of students' positive outcomes, teachers and their behaviours have become focal points of research and educational policies (Chetty et al., 2014; Kunter et al., 2013; León et al., 2017; León et al., 2018). Recently, researchers have drawn attention towards teachers' behaviours, such as their use of messages, presenting promising results (León et al., 2017). Particularly,

previous studies have shown that teachers' messages have an impact on students' psychological well-being, on-task behaviour, and academic performance (Caldarella et al., 2020; Ntoumanis et al., 2017; Putwain et al., 2017; Putwain & Roberts, 2009; Santana et al., 2019). Despite the progress made in the area, more evidence is needed to understand why teachers rely on certain messages (Santana et al., 2019) and how that might relate to certain student outcomes such as academic performance. For instance, Korthagen and Evelein (2016) studied how the "inner side" of teachers (e.g., feelings, emotions, thoughts, etc.) affected their "outer side" (e.g., teaching quality, teaching behaviour, etc.). Specifically, these authors offered evidence of significant relations between teachers' basic needs and their teaching behaviour. Considering teachers' engaging messages as a verbal teaching behaviour, it might be expected that teacher's basic needs have an

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influence on the engaging messages they rely on. Therefore, the following research question was investigated: Are teacher's basic needs related to their use of engaging messages? More precisely, the present study aimed to: 1) test if the fulfilment or the thwarting of teachers' basic psychological needs is related to their use of engaging messages; and 2) examine if student outcomes, such as academic performance, are related to the engaging messages teachers' rely on.

## 1. Engaging messages

Teachers' engaging messages have been defined as the different messages teachers rely on to engage students in school tasks (Santana et al., 2019). These messages are characterized by focusing on the consequences associated to certain outcomes, which can either be favorable (referred to as *gain-framed messages*) or unfavorable (referred to as *loss-framed messages*). These messages are also characterized by supporting a certain type of motivation (external, introjected, identified or intrinsic), referred to as *motivational appeals* (Santana et al., 2019). Researchers, who have approached the study and measurement of teachers' engaging messages via student perceptions, have conceptualised it following two theories: The message framing theory (Rothman & Salovey, 1997) and the self-determination theory (Deci & Ryan, 2016; Ryan & Deci, 2000, 2017, 2020).

### 1.1. Message framing theory

Teachers' engaging messages refer to both the frame and the motivational appeals within a given message. Attending to the frame, messages can generate different outcomes depending on whether they are gain or loss-framed (Rothman & Salovey, 1997). Gain-framed messages emphasise the benefits of engaging in a specific activity, whereas loss-framed messages highlight the expenses of not doing so. When applied to educational contexts, teachers can engage students in school-tasks either by telling them that, if they do so, they could choose what to study once they finish school (i.e., gain-framed message), or by telling them that, if they do not do so, they would have to pursue a less demanded degree (i.e., loss-framed message). Clearly, both messages use the same stimulus as a reference (i.e., choice of future studies) but the message is framed differently. Thus, the focus here is the frame of the message and not the stimuli or the motive appealed to.

Few researchers have followed this approach, but those who have, have provided evidence of the negative consequences that loss-framed messages can have on students (Putwain & Remedios, 2014; Putwain & Symes, 2016). For instance, Putwain and Roberts (2009) reported that loss-framed messages could be perceived by students as threatening, thereby increasing anxiety levels. However, the effects of gain-framed messages remain largely unexplored. For instance, only two studies have examined both loss and gain-framed messages simultaneously (Putwain & Symes, 2016; Symes & Putwain, 2016). Moreover, in these studies, the messages were not investigated by directly measuring teachers' behaviour, but instead were measured under hypothetical settings resulting in mixed findings. This gap in research highlights the need for more studies examining the effects that gain-framed messages can have on students.

### 1.2. Self-determination theory

Attending to motivational appeals, researchers (Deci & Ryan, 2016; Ryan & Deci, 2000, 2017, 2020) have identified four different types of motivations that drive behaviour. These four types of motivations can be categorised as autonomous (i.e.,

identified and intrinsic) or controlled (i.e., external and introjected). In such way, teachers can use their messages to engage their students in school related tasks by appealing to one type of motivation or another. For instance, when teachers appeal to controlled motivations, student's behaviour is driven by external sources such as rewards or punishments (i.e., extrinsic motivation), or by internal sources, such as guilt or self-esteem (i.e., introjected motivation). In contrast, when teachers appeal to autonomous motivations student's behaviour is controlled either by the value attributed to a certain activity (i.e., identified motivation), or by the pleasure and enjoyment of the activity itself (i.e., intrinsic motivation). Each type of motivation would have a different degree of self-determination, ranging from the least self-determined motivation to the most in the following order: Extrinsic, introjected, identified, and intrinsic (Behzadnia et al., 2018; Ryan & Deci, 2020). Despite the different types of motivations, sometimes teachers may not appeal to a motivation at all. Such messages highlight that there is no existing relation between student's behaviour and the outcomes related to such behaviour. In such situations, students might feel amotivated and experience a lack of control (Núñez & León, 2015). Previous research has shown that when students are autonomous motivated, they perform better, achieve conceptual and self-regulated learning, engage in school tasks, and experience higher satisfaction and enjoyment through their engagement in specific activities (Froiland & Worrell, 2016; Jang et al., 2016; León et al., 2015; Ryan & Deci, 2020).

Under the self-determination framework, researchers have identified a series of teaching practices that support students' needs, foster their motivation, and relate with their outcomes, known as need-supportive teaching (Collie et al., 2019; Haerens et al., 2015, 2018; Vansteenkiste et al., 2012). A need-supportive teaching style is characterized by nurturing students' needs and interests. It has also been linked to students' motivation, learning strategies, and behaviours (Haerens et al., 2015; Vansteenkiste et al., 2012). In contrast a controlling teaching style is characterized by pressuring students to behave in a certain way and has shown to predict students' disengagement and lower their academic achievement (Collie et al., 2019). Amidst these practices, teacher messages have been assessed as a way of relying on an inviting (i.e., "you could") or a controlling language (i.e., "you must"; Haerens et al., 2015; Núñez & León, 2015; Reeve, 2009; Vansteenkiste et al., 2012). Nevertheless, this way of approaching the study of teacher messages does not consider the different types of motivation that could be communicated in a more or less controlling way. Attending both the message framing theory and the self-determination theory might help to better understand how teaching practices impact student outcomes. As a practical implication, teachers may benefit more from this theoretical approach as it addresses the specific messages they can use in class (i.e., "my teacher tells me that if I work hard, I will learn interesting facts") rather than focusing on a type of language, which in some cases could seem too vague (i.e., "my teacher uses forceful language"; Jang et al., 2016). Finally, it could be also helpful for the design of future interventions and teacher training programs, as asking teachers to rely on a certain message and avoid others is low-cost, easy to implement, and does not require much time.

### 1.3. Integrating the theories

The present study aimed to integrate the message framing theory and self-determination theory in order to provide a more comprehensive view of teachers' engaging messages. It also aims to fill in the literature gaps in both the theories by examining gain-framed and loss-framed messages, as well as the different motivational appeals that teachers rely upon. As Busemeyer (2017) and

Gigerenzer (2017) recommend, it is important not only to rely on a meta-theory but also to aim for the integration of different theories to improve the study of human learning and behaviour. Combining these theories would greatly enrich the study of teachers' engaging messages as they can both complement and overcome each other's weaknesses (see Table 1 for examples of the different messages teachers can rely on resulting from the theory integration). For instance, the message framing theory does not consider the motives appealed within a message, instead, it only examines the message frame, when in fact motivational appeals could contribute to students' outcomes. Similarly, the self-determination theory does not take into account the frame of the message when teachers appeal to a certain kind of motivation. Nonetheless, Putwain and Roberts (2009) have demonstrated that loss-framed messages can have negative effects on students.

Recently, in a preliminary study, Santana et al. (2019) combined both the theories to offer a deeper understanding of teachers' engaging messages. Their findings acknowledged that teachers' engaging messages have an impact on students' psychological well-being. Furthermore, they also identified three profiles of teachers according to students' perceptions: teachers who used few messages, teachers who used all kind of messages, and teachers who relied mostly on gain-framed messages and on more self-determine motivational appeals (i.e., autonomous motivations such as intrinsic and identified). Students who reported having a teacher in this last profile reported higher levels of psychological well-being. Nevertheless, there is still a need to explore the predictors of teachers' engaging messages in order to successfully design future interventions.

## 2. Teachers' basic needs as a predictor of their engaging messages

In the school context, the basic psychological needs mini-theory suggests that teachers have three innate basic needs: autonomy, competence, and relatedness (Ryan & Deci, 2017). The need for autonomy refers to a sense of initiative and the capability to decide to take part, or not, in a certain activity. Teacher's behaviour is therefore driven by their willingness and by interest (Deci & Ryan, 2000; Ryan & Deci, 2020). In this sense, teachers feel that their need for autonomy is satisfied when the head teacher considers their perspective, supports their initiatives, and provides meaningful reasons when making a demand. The need for competence refers to effectively interacting with one's environment. Teachers whose competence need is satisfied, feel that they have the capability to perform their job effectively (Lee & Nie, 2014). Finally, relatedness refers to the desire to feel significantly related to and bonded with others. Teachers' need for

relatedness would be satisfied when they feel connected with and supported by both their students and their colleagues (Behzadnia et al., 2018; Deci & Ryan, 2000; Ryan & Deci, 2000).

In educational contexts, the fulfilment of these needs in teachers would not only be essential for their optimal functioning and well-being (Deci & Ryan, 2008), but it would also affect their teaching behaviours (Klaeijnsen et al., 2018; Praetorius et al., 2017; Van den Berghe et al., 2014), whereas the thwarting of these needs would lead to negative teaching outcomes and less effective teaching behaviours (Marshik et al., 2017; Martinek, 2019; Pelletier et al., 2002). It is important to note that need thwarting is not the same as the absence of need fulfilment (Ebersold et al., 2019). When a need is poorly satisfied individuals' growth attenuates, but when a need is thwarted individuals are more vulnerable to ill-being (Bartholomew et al., 2011; Chen et al., 2015; Vansteenkiste & Ryan, 2013). This implies that when teachers' needs for autonomy, competence, and relatedness are thwarted, they feel controlled and pressured, their sense of self-efficacy declines, and feel excluded and lonely, respectively (Chen et al., 2015).

The relation between "inner" aspects of teaching, such as teachers' beliefs, emotional experiences, attitudes or well-being, and their actual behaviour in the classroom (i.e., "the outer side") has been widely addressed among researchers over time, providing sufficient empirical evidence on their relation (Bandura, 1978; Kunter et al., 2013; Shen et al., 2015). However, as Korthagen and Evelein (2016) remarked, among these inner aspects of teaching, teachers' basic psychological needs (i.e., autonomy, relatedness, and competence) and its link with teaching behaviour as observed by students (e.g., engaging messages) remains understudied. Likewise, the thwarting and fulfilment of these needs has been poorly addressed simultaneously (Bartholomew et al., 2011; Cuevas et al., 2015; Ebersold et al., 2019). For instance, although Korthagen and Evelein (2016) found that when teachers' basic psychological needs (inner side of teaching) were satisfied, they displayed a behaviour characterized by a high level of influence and proximity (outer side of teaching); researchers did not measure how need thwarting influenced the teachers' behaviour.

The present study fills this gap in research and expands previous works by taking a wider perspective based on the three basic psychological needs, both their thwarting and fulfilment, and by connecting the inner side of teaching with its outer side. In other words, this study attempts to relate teachers' need fulfilment or thwarting with their use of engaging messages. This wider perspective allows us to examine more complex relations between teachers' personal aspects and their behaviours, while considering both teachers' and students' perspectives. Thus, in order to acquire a better understanding of the dynamics underlying teachers'

**Table 1**  
Teachers' engaging messages.

| Message frame | Motivational appeals | Example   |
|---------------|----------------------|---|
| Gain-frame    | Intrinsic            | Gain-framed intrinsic messages: "If you work hard, you will learn interesting facts."                                   |
|               | Identified           | Gain-framed identified messages: "If you work hard, you will be prepared for your future studies."                      |
|               | Introjected          | Gain-framed Introjected messages: "If you work hard, you will feel proud of yourself."                                  |
|               | Extrinsic            | Gain-framed extrinsic messages: "If you work hard, I'll give you a reward (star, sticker, etc.)."                       |
| Loss-frame    | Intrinsic            | Loss-framed intrinsic messages: "Unless you work hard, you will miss the opportunity to understand interesting issues." |
|               | Identified           | Loss-framed identified messages: "Unless you work hard, you will only be able to get low paid jobs."                    |
|               | Introjected          | Loss-framed introjected messages: "Unless you work hard, you will feel ashamed."  |
|               | Extrinsic            | Loss-framed extrinsic messages: "Unless you work hard, you will miss your break."                                       |
| Amotivation   |                      | Amotivation messages: "It does not matter if you work hard, you will fail anyway."                                      |

engaging messages, and in turn, students' academic performance, attending to the teachers' behavioural predictors should be a priority for researchers.

### 3. Teachers' engaging messages: A person-centered and multilevel approach

#### 3.1. Person-centered approach

For this study, taking a person-centered approach would help in examining the profiles of teachers with a similar use of engaging messages (e.g., teachers that rely on gain-framed and autonomous messages). Unlike variable-centered approaches, person-centered approaches allow researchers to examine the existence of possible subpopulations of teachers that share characteristics within a unique sample, such as their engaging messages (Collie et al., 2020). In contrast, a variable-centered approach informs about the existent relations between variables in the same population. As a practical implication, person-centered approaches could be helpful in guiding future interventions based on the necessities displayed by each profile identified within a sample of teachers, whereas variable-centered approaches would only give us information about the variables that may be the subject of a wider intervention (Lanza & Rhoades, 2013). For instance, interventions following a variable-center approach would target teachers equally, this is to say that all teachers would be told the kind of messages they should rely on. Contrastingly, interventions following a person-center approach would adapt the intervention towards the profile displayed by teachers. For example, teachers identified as relying on all kinds of messages could be told to stop relying on loss-framed messages, given the inconvenience associated with them (Putwain & Symes, 2016).

#### 3.2. Multilevel approach

In the educational context, researchers usually deal with variables located at different levels. In our study we deal with two levels: Level 1 (L1 or student-level) and Level 2 (L2 or teacher-level). Two kinds of Level 2 variables are frequently used: (1) variables that have the same value for all the students of a teacher (e.g., teachers' basic needs), and (2) variables based on the aggregate of students' responses (e.g., teachers' engaging messages). When combining latent profile analysis with a multilevel approach we can obtain different profiles for each level of analysis. At Level 1, we can identify profiles of students according to the engaging messages their teacher uses with them, whereas at a Level 2, we can identify profiles of teachers according to the proportion of Level 1 profiles.

These kind of designs, in which the nature of the data is taken into account, allow us to approach a more thorough understanding of the effect these messages have on students. In this research, personalised messages directed towards an individual student (analysis at L1), are differentiate from teacher's overall tendency to use a message with the whole class (analysis at L2; Marsh et al., 2012; Morin et al., 2014).

#### 3.3. The present study

In the present study, profiles of teachers' engaging messages were examined along with their relation to the teachers' basic needs (L2) and students' academic performance (L1 and L2). In the first stage, profiles of students were identified according to the engaging messages that the teacher used with them and examined how these profiles were related to students' academic performance. In the second stage, profiles of teachers were examined according to the engaging messages they used in class with their

students and how these profiles were related to their basic needs and the students' academic performance.

Based on the recent evidence about the outcomes related to certain teaching behaviours (Putwain & Symes, 2016; Ryan & Deci, 2020) and the impact that teachers' basic needs have on their own behaviour (Korthagen & Evelein, 2016), it was expected to find that specific profiles would relate to teachers' basic needs. It was also expected to find differences in students' academic performance based on their teachers' use of engaging messages. Specifically, it was expected that profiles characterized by the use of gain-framed messages and self-determined appeals would be related to teachers' basic needs fulfilment and students' optimal academic performance.

## 4. Method

### 4.1. Participants

A total of 48 teachers (60.4 % female; age range = 26–58; mean age = 46.38,  $SD = 8.07$ ) and their 1150 students (50.4 % women; Mean age = 15.15,  $SD = 1.46$ ) from grades 8th to 12th participated in the study (Mean students per classroom = 18.69,  $SD = 6.64$ , range = 7–34). The participants belonged to ten public secondary schools of the island of Gran Canaria, Spain, belonging to both rural and urban environments. To diminish potential bias all students were studying the same subject and attended an equal number of hours of classes per week. The questions were specific to one subject, mathematics, and therefore referred to students' mathematics teacher.

### 4.2. Procedure

Data collection took place during the first trimester of the 2018–2019 academic year. The objectives of the study were explained to the students and teachers, emphasizing the voluntary and confidential nature of their participation. The teachers filled in the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015), while students assessed the engaging messages of their teacher through the instrument developed by León et al. (2019). Both instruments were administered in the classroom during a teaching period.

### 4.3. Instruments

Items for both instruments were rated according to a Likert scale of seven points from 1 (*absolutely not true*) to 7 (*absolutely true*). To examine reliability of the used instruments, McDonald's Omega was used instead of Cronbach's alpha, because the latter assumes that the factor loadings are the same for all (Hancock & An, 2020) and McDonald's Omega has shown evidence of better accuracy than Cronbach's alpha (McNeish, 2018). McDonald's Omega were estimated using factor loadings from a congeneric CFA for each variable.

#### 4.3.1. Teachers' engaging messages

Teachers' engaging messages were assessed by students using the instrument developed by León et al. (2019). The scale comprises a total of 36 items preceded by the phrase, "My teacher tells me that ...". Items are grouped by four into nine factors, one for each degree of self-determination and its frame: gain-frame intrinsic (e.g., "If I work hard I will enjoy this subject"), loss-frame intrinsic (e.g., "Unless I work hard I will miss the beauty of this subject"), gain-frame identified (e.g., "If I work hard I will be able to choose what to study"), loss-frame identified (e.g., "Unless I work hard I will have a hard life"), gain-frame introjected (e.g., "If I work hard I

will feel important”), loss-frame introjected (e.g., “Unless I work hard I will feel sad”), gain-frame extrinsic (e.g., “If I work hard I will receive compliments”), loss-frame extrinsic (e.g., “Unless I work hard I will get into trouble”), and amotivation messages (e.g., “It does not matter if I work hard, I will fail anyway”). Model fit indices for the CFA were as follows:  $\chi^2(558) = 1851.053$ ,  $p < .001$ , RMSEA = 0.045, CFI = 0.922. The reliability and validity of this scale has been previously established displaying values of McDonald’s Omega above 0.81 for each factor (Santana et al., 2019). In the present study, McDonald’s omega for each of the nine factors was above 0.85.

#### 4.3.2. Basic psychological needs

To evaluate perceived thwarting and fulfilment of teachers’ basic psychological needs, teachers completed the Spanish version for adults of the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015). The instrument is comprised of 24 items preceded by the phrase “In my workplace”. The items are divided into six factors of four items each, one for each need frustrated and satisfied: autonomy satisfaction (e.g., “I feel my choices express who I really am”), autonomy frustration (e.g., “I feel pressured to do too many things”), relatedness satisfaction (e.g., “I feel that the people I care about also care about me”), relatedness frustration (e.g., “I feel excluded from the group I belong to”), competence satisfaction (e.g., “I feel confident that I can do things well”), and competence frustration (e.g., “I feel disappointed with many of my performances”). Previous research has provided evidence of reliability and validity of the scale (Liga et al., 2018). In the present study, McDonald’s omega for need fulfilment factors was above .84, whereas for need thwarting factors was above 0.75.

#### 4.3.3. Academic performance

Students’ academic performance was measured by their grades in mathematics retrieved from the schools’ official records. In the Spanish education system grades are granted by students’ teachers, following rubrics implemented by the government. These rubrics cover students’ knowledge and ability in a given subject as well as their work done during classes and homework. Similar to standardized test results, teacher reported grades are very important for students’ future as they determine the universities and courses that students can have access to. The grades ranged from 1 to 10, 10 being the highest possible grade (León et al., 2017).

### 4.4. Data analyses

All data analyses were conducted with Mplus 8.6 (Muthén & Muthén, 2021). Students were clustered within classrooms in the single level models using the “type = complex” command in Mplus. The robust maximum likelihood (MLR) estimator was used in all models. These were estimated using at least 5000 random start values, each allowing 100 initial stage iterations, and 100 final stage optimizations. There was no missing data for teacher variables whereas for variables reported by students, missing data accounted for 1–14 %. Missing data were handled with the full information maximum likelihood approach. To test the different models, an invariant modeling approach was followed where variances were made constant. In addition, to ease interpretation, all variables were standardized to mean 0 and standard deviation of 1 (Collie et al., 2020). This approach allows to easily interpret means in the latent profile results: if data are above 0 and with a low  $p$ , we can observe that the value is above the mean.

#### 4.4.1. Single level latent profile analysis

Latent profile analysis is used to explain the variability within a population using the fewest number of latent profiles possible (Korpipää et al., 2019). This procedure classifies participants based

on the probability of belonging to a certain profile and relies on fit indices to decide the number of profiles, unlike traditional cluster analysis (Morin & Marsh, 2015; Stanley et al., 2017). Specifically, the following indices were used to decide the number of latent profiles: Log-Likelihood (LL), Akaike Information Criteria (AIC), Sample Size Adjusted Bayesian Information Criteria (SSA-BIC), and Likelihood Ratio Test (LRT). Lower values of LL, AIC, and SSA-BIC are indicators of better fit than higher values. LRT informs if the fit of a model with  $k$  latent profile is better than the fit of a model with  $k-1$  profile. A low  $p$ -value indicates that a model with  $k$  groups fits better than a model with  $k-1$  groups (Lo et al., 2001). Because one disadvantage of latent profile analysis is that a solution with a small number of participants may not represent a unique latent profile (Marsh et al., 2009), the percentage of cases in the smallest latent subgroup of each model (e.g., 1 % or 5 % of the total sample) was also analysed. To show the flattening of these indices an elbow plot was created. A clear elbow is an indicator of a suitable solution (Morin et al., 2016).

Following Mäkikangas et al. (2018) and Collie et al. (2020) recommendations, a two-step procedure was followed. In a first step, single latent profile analysis were estimated to decide the number of clusters at L1 or student-level. At this level, 1 to 8 solutions were tested. To estimate the variable scores, factor scores were used to diminish the effect of measurement errors (Justice et al., 2011). Factor scores were saved from the 9-factor measurement model and standardized ( $M = 0$  and  $SD = 1$ ). Model fit indices and examples for each factor of this single level latent model are provided in the instruments section. To analyse differences in the academic performance of students between the different profiles, the Bolck-Croon-Hagenaars (BCH; Bolck, Croon, & Hagenaar, 2004) method was used (Asparouhov & Muthén, 2014b). Unlike the classic ANOVA this method considers the probability of belonging to each profile instead of assuming subjects belong just to one profile (Asparouhov & Muthén, 2014a).

#### 4.4.2. Multilevel latent profile analysis

In a second step, multilevel latent profile analysis were performed. The multilevel version of this analytic approach is used to explore the profiles at a higher level (i.e., students at Level 1 and teachers at Level 2), for example, based on the proportion of Level 1 profiles on the Level 2 profiles (Collie et al., 2020). Thus, based on the results of step 1 regarding teachers’ use of messages, a multilevel latent profile analysis was performed to explore teachers’ profiles with different percentages of L1 profiles. At Level 2, a range of 1–3 profile solutions were tested.

Data on teachers’ basic psychological needs were modelled using mean scores given that the teacher sample size was not big enough in order to rely on factor scores. To test if the likelihood of belonging to a multilevel latent profile depends on teacher’s autonomy, competence, and relatedness, a logistic regression analysis was performed. The correct interpretation of a logistic regression implies the understanding of the difference between probability, odds ratio, and logit. A probability informs about how likely is something to happen, an odds ratio informs of the probability of one group compared to another group, and is the ratio of two probabilities. For example, when comparing the probability of studying a STEM degree among men and women, an odd ratio of 1.5 would mean that men are 50 % more likely to study a STEM degree than women. Finally, the logit provides the same information of the odds ratio but in another scale, and is the  $b$  regression coefficient. The logit is the logarithm of the odds ratio, in our example it would be  $\text{Log}(1.5) = 0.18$  (Wooldridge, 2020).

In the above example the predictor (gender) is a categorical variable, however, in our study the predictor (autonomy, competence, and relatedness) is a continuous variable, thus, the interpretation for odds ratio is different. In our study, the interpretation

would be: For every unit (i.e., standard deviation) increase in the predictor, the likelihood of pertaining to one group when compared to the other group increases or decreases an X percentage.

At level 2, similar to Collie et al. (2020), academic performance was compared between the different profiles using the delta method under the Mplus MODEL CONSTRAINT option. To aggregate academic performance to these models the mean academic performance per class was calculated relying on the raw student data.

## 5. Results

### 5.1. Preliminary analyses

The descriptive statistics (mean and SD) and correlations for student and teacher variables are shown in Tables 2 and 3.

### 5.2. Single level latent profile analysis

Table 4 displays the fit indices for the latent profile analysis conducted at the student-level. Findings show that six to eight profile models hold groups with very low percentages of subjects. Given that solutions with a small number of participants may not represent a unique latent profile (Marsh et al., 2009) six to eight profiles were rejected. Four and five profile models were rejected by LRT values (high *p* values). A three-profile model was assumed due to the lower values of LL, AIC, and SS-BIC in comparison with a two-profile model, a statistically significant LRT value, a reasonable percentage of subjects in the smallest group and the slope flattening depicted in the elbow plot in Fig. 1. Furthermore, following our theoretical approach, a three-profile solution was also retained because it best described the differential use of messages by teachers. More profiles did not add further information on the messages that teachers were using.

The characteristics and names of the profiles were as follows: Profile 1 as *gain-framed messages* (GFM) with a total of 549 students (48 % of the sample). Students in this profile classified their teacher as relying on gain-framed messages that highlighted the benefits of studying, and on motivational appeals with the highest levels of self-determination (i.e., intrinsic and identified); Profile 2, as *all messages* (AM) with a total of 278 students (24 % of the sample) that classified their teacher as using all kinds of messages, both gain-framed and loss-framed, including motivational appeals with all degrees of self-determination; and Profile 3, as *few messages* (FM) with a total of 323 students (28 % of the sample) who reported their teacher as barely relying on the messages assessed. Single-level profile analysis results are displayed in Fig. 2.

Regarding the differences between the profiles at the student-

**Table 2**  
Means, standard deviations and correlations among student variables.

|                            | Mean | SD   | 2                | 3                | 4                | 5                | 6                | 7                | 8                | 9                 | 10                |
|----------------------------|------|------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| 1. Gain-framed intrinsic   | 4.07 | 1.50 | .60 <sup>c</sup> | .69 <sup>c</sup> | .62 <sup>c</sup> | .41 <sup>c</sup> | .18 <sup>c</sup> | .26 <sup>c</sup> | .15 <sup>c</sup> | -.06 <sup>a</sup> | .16 <sup>c</sup>  |
| 2. Gain-framed identified  | 5.00 | 1.55 | –                | .63 <sup>c</sup> | .54 <sup>c</sup> | .38 <sup>c</sup> | .28 <sup>c</sup> | .25 <sup>c</sup> | .18 <sup>c</sup> | -.08 <sup>b</sup> | .08 <sup>a</sup>  |
| 3. Gain-framed introjected | 4.17 | 1.69 | –                | –                | .71 <sup>c</sup> | .35 <sup>c</sup> | .29 <sup>c</sup> | .35 <sup>c</sup> | .25 <sup>c</sup> | -.02              | .00               |
| 4. Gain-framed extrinsic   | 4.34 | 1.52 | –                | –                | –                | .34 <sup>c</sup> | .29 <sup>c</sup> | .33 <sup>c</sup> | .30 <sup>c</sup> | -.04              | .03               |
| 5. Loss-framed intrinsic   | 3.57 | 1.57 | –                | –                | –                | –                | .49 <sup>c</sup> | .55 <sup>c</sup> | .45 <sup>c</sup> | .01               | .04               |
| 6. Loss-framed identified  | 2.75 | 1.67 | –                | –                | –                | –                | –                | .79 <sup>c</sup> | .70 <sup>c</sup> | .18 <sup>c</sup>  | -.08 <sup>a</sup> |
| 7. Loss-framed introjected | 2.32 | 1.57 | –                | –                | –                | –                | –                | –                | .76 <sup>c</sup> | .18 <sup>c</sup>  | -.07              |
| 8. Loss-framed extrinsic   | 2.41 | 1.49 | –                | –                | –                | –                | –                | –                | –                | .15 <sup>c</sup>  | -.11 <sup>b</sup> |
| 9. Amotivation             | 1.30 | .91  | –                | –                | –                | –                | –                | –                | –                | –                 | -.11 <sup>b</sup> |
| 10. Academic performance   | 5.22 | 2.18 | –                | –                | –                | –                | –                | –                | –                | –                 | –                 |

Note.  
<sup>a</sup> *p* < .05.  
<sup>b</sup> *p* < .01.  
<sup>c</sup> *p* < .001.

**Table 3**  
Means, standard deviations, correlations among teacher variables.

|                           | Mean | SD   | 2                | 3                | 4                 | 5                 | 6                 |
|---------------------------|------|------|------------------|------------------|-------------------|-------------------|-------------------|
| 1. Satisfied autonomy     | 5.51 | .95  | .70 <sup>c</sup> | .37 <sup>a</sup> | -.46 <sup>b</sup> | -.65 <sup>c</sup> | -.37 <sup>a</sup> |
| 2. Satisfied relatedness  | 5.82 | 1.09 | –                | .60 <sup>c</sup> | -.37 <sup>a</sup> | -.80 <sup>c</sup> | -.50 <sup>c</sup> |
| 3. Satisfied competence   | 6.05 | .73  | –                | –                | -.27              | -.40 <sup>b</sup> | -.42 <sup>b</sup> |
| 4. Frustrated autonomy    | 3.04 | 1.22 | –                | –                | –                 | .45 <sup>b</sup>  | .45 <sup>b</sup>  |
| 5. Frustrated relatedness | 1.59 | .71  | –                | –                | –                 | –                 | .50 <sup>c</sup>  |
| 6. Frustrated competence  | 1.88 | 1.07 | –                | –                | –                 | –                 | –                 |

Note.  
<sup>a</sup> *p* < .05.  
<sup>b</sup> *p* < .01.  
<sup>c</sup> *p* < .001.

level in academic performance, students in the GFM profile had higher academic performance. When comparing the three profiles together, the GFM profile demonstrated a significantly higher mean (*p* < .05;  $M_{GFM} = 5.39$ ,  $M_{FM} = 4.93$ ) than the FM profile, whereas no significant differences were found between the rest of the profiles (FM vs. AM: *p* = .89; GFM vs. AM: *p* = .07;  $M_{AM} = 5.03$ ).

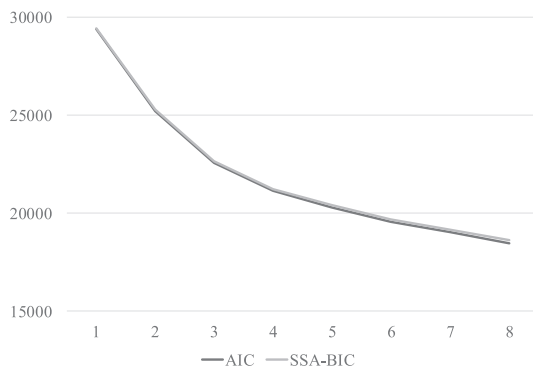
### 5.3. Multilevel latent profile analysis

Table 5 displays the fit indices to decide the number of profiles in the multilevel latent profile analysis. Findings indicate that the three-profile solution showed a similar fit to the two-profile solution, which showed a better fit than the one-profile solution. Given that the elbow plot displayed a clear change in the slope after the two-profile (see Fig. 3), this solution was retained. Furthermore, theoretically a two profile solution demonstrated to be better than the one or three solution given that it was the only one to add new information on the differential use of messages by teachers. One profile described just one group of teachers relying on the same kind of messages found at L1, and the three profile solution reported two very similar groups. Precisely, it described a group of teachers that barely used these messages and two groups of teachers that relied mainly on gain-framed messages. Thus, a two profile solution was retained.

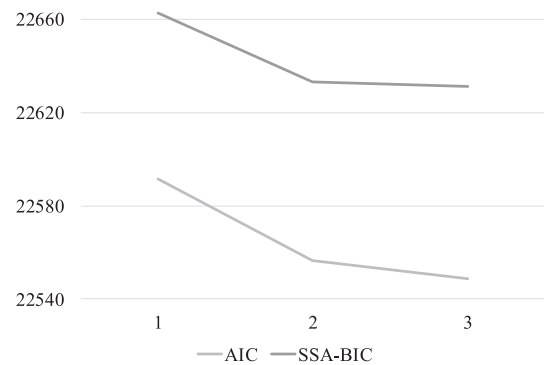
A representation of the results for the multilevel latent profile analysis at the teacher-level is illustrated in Fig. 4. Results showed two teacher profiles: An active profile representing the 77 % of the sample and a passive profile representing the remaining 23 % of the sample. The active profile was characterized by teachers whose tendency was to rely on gain-framed messages and motivational appeals with the highest self-determination (i.e., intrinsic and identified; 53.6 % of the teachers) including a relatively small proportion of teachers whose tendency was to rely on all kinds of messages (25.6 %) and few messages (20.8 %). Contrastingly, the

**Table 4**  
Fit indices for each model of the single level latent profile analysis.

| Profiles | Parameters | LL         | AIC       | SSA-BIC   | LRT <i>p</i> | % Smallest Group |
|----------|------------|------------|-----------|-----------|--------------|------------------|
| 1        | 18         | -14686.014 | 29408.028 | 29441.709 | —            | —                |
| 2        | 28         | -12589.988 | 25235.976 | 25288.369 | .0002        | 28               |
| 3        | 38         | -11257.858 | 22591.716 | 22662.822 | .0118        | 24               |
| 4        | 48         | -10531.483 | 21158.967 | 21248.785 | .0682        | 12               |
| 5        | 58         | -10090.603 | 20297.206 | 20405.736 | .6080        | 11               |
| 6        | 68         | -9716.327  | 19568.654 | 19695.895 | .3561        | 5                |
| 7        | 78         | -9437.517  | 19031.034 | 19176.988 | .7130        | 6                |
| 8        | 88         | -9145.930  | 18467.859 | 18632.525 | .2118        | 5                |



**Fig. 1.** Elbow plots for single level latent profile analysis.



**Fig. 3.** Elbow plots for multilevel latent profile analysis.

passive profile was characterized by teachers with a tendency to rely on very few messages (51.3 %), with a moderate proportion of teachers belonging to the GFM profile (29.6 %), followed by teachers whose tendency was to use all kinds of messages (19.1 %).

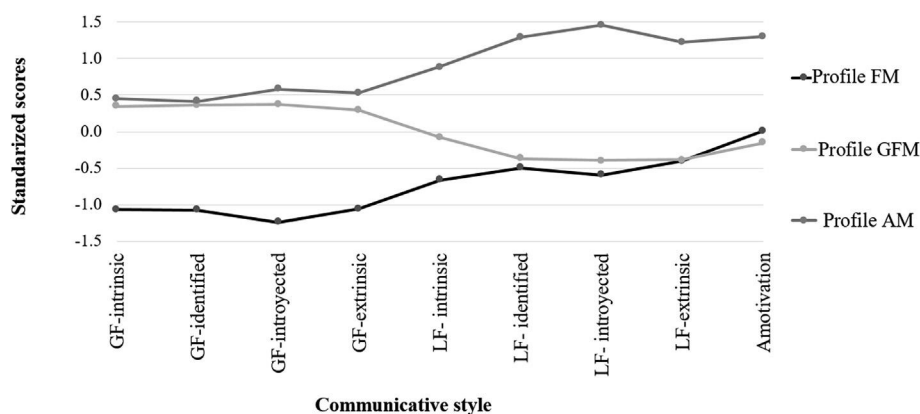
Analysis of the relation between the profiles of teachers' engaging messages and the fulfilment or thwarting of their needs at a teacher-level yielded significant results for the need for autonomy (see Table 6). In such a way that when the need for autonomy was fulfilled, the likelihood of pertaining to the active profile was four times greater than that of the passive profile. In contrast, when this need was thwarted the likelihood of pertaining to the passive

profile was three times greater than the likelihood of pertaining to the active profile.

Finally, regarding differences in students' academic performance at the teacher-level between the different profiles, students who perceived their teacher as relying on the messages of the active profile showed higher academic performance ( $p < .001$ ;  $M_{active} = 6.32$ ,  $M_{passive} = 4.61$ ).

**6. Discussion**

The present study follows a person-centered approach to



**Fig. 2.** Single level profile analysis results. Note. GF= Gain-framed; LF=Loss-framed

**Table 5**  
Fit indices for each model of the multilevel latent profile analysis.

| Profiles | Parameters | LL         | AIC       | SSA-BIC   | % Smallest Group |
|----------|------------|------------|-----------|-----------|------------------|
| 1        | 38         | -11257.859 | 22591.717 | 22662.823 | 24               |
| 2        | 41         | -11237.169 | 22556.338 | 22633.058 | 4                |
| 3        | 44         | -11230.376 | 22548.752 | 22631.085 | 2                |

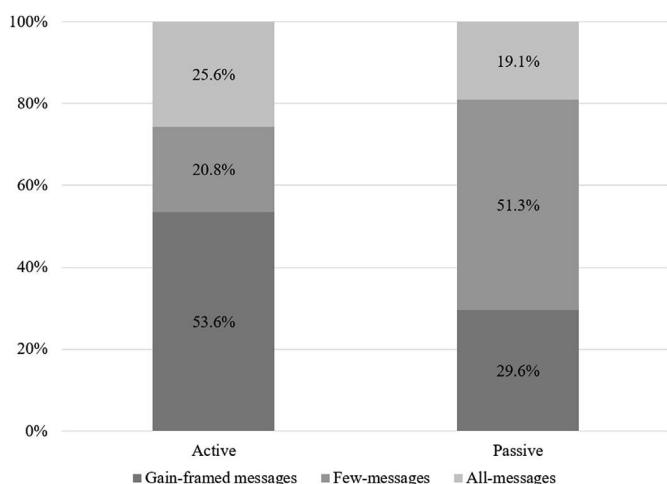


Fig. 4. Multilevel profile analysis results.

identify profiles of teachers' engaging messages and its relation to the teachers' basic needs and students' academic performance. At the student-level, three different profiles are identified: The gain-framed messages profile (GFM), the few-messages profile (FM), and the all-messages profile (AM). Results show that, indeed, the different profiles relate differently to students' academic performance. At the teacher-level, evidence indicates the existence of two profiles: A passive profile of teachers who pertain mostly to the FM profile and an active profile of teachers who pertain mostly to the GFM profile. Results show that the need for autonomy is related to teachers' use of engaging messages and that those students whose teacher pertains to the active profile have a higher academic performance.

### 6.1. Single-level latent profile analysis

As expected, different profiles are found at the student-level. Specifically, three profiles can be observed. The gain-framed messages (GFM) profile represents 48 % of the sample. This profile comprise students who describe their teacher as mainly relying on gain-framed messages during their classes, and within this frame, they also report their teacher relying on a greater proportion on self-determined appeals (i.e., intrinsic and identified). The second profile, labelled the all-messages (AM) profile, represents 24 % of the sample. This profile comprises students who recalled their teacher as using both gain- and loss-framed messages but also relying more on extrinsic and introjected motivational appeals. Finally, the few-messages (FM) profile represents 28 % of the sample. This profile is characterized by students who report having a teacher that barely rely on any of the messages addressed.

These findings help to understand the classification of teachers' messages according to the messages they use to engage their students in school tasks. More specifically, owing to this classification, almost half of the teachers are described as using messages that highlight the positive outcomes of engaging in school tasks (e.g.,

freedom to choose the degree after finishing the school). Despite these optimistic results, one in four teachers are classified as relying on messages that highlight the negative outcomes of not complying with school duties. Putwain and colleagues (Putwain & Remedios, 2014; Putwain & Roberts, 2009; Putwain & Symes, 2016) have demonstrated that these kind of messages lead to non-adaptive outcomes in students (e.g., anxiety and low performance). On the other extreme, one in five teachers were described by their students as barely relying on any kind of messages that tried to encourage them to engage in school tasks.

In this sense, results show that the students whose teacher rely on gain-framed messages, and assign their teacher to the GFM profile, have a higher academic performance as compared to the other two profiles, whose academic performance is below the mean. These results are similar to those of Putwain et al. (2017), who found that loss-framed messages predicted worse student academic performance. In the Spanish education system grades are an indicator of students' performance and are assigned by teachers following rubrics implemented by the government. Students depend on these grades to choose universities and degrees; thus, they are key for their future career (León, 2017; Sánchez-Pérez et al., 2015).

### 6.2. Multilevel latent profile analysis

With regard to the teacher-level, two profiles can be observed, named active and passive. The active profile represents the 77 % of the sample and is characterized by teachers whose tendency is to use messages to engage their students in school duties. The passive profile represents 23 % of the sample and is characterized by teachers whose tendency is to barely use any message. It is important to highlight the differences between profiles at the student-level and at the teacher-level. The former is an indicator of the engaging messages that a single student perceived on their teacher, while the latter is an indicator of the tendency of the teacher to use certain messages, derived from the aggregation of profiles at the student-level. The findings indicate that, in the active profile more than half of the teachers belong to the GFM profile, and in the passive profile more than half of the teachers belong to the FM profile.

Regarding the relation between the teachers' needs and the two profiles, results show that the need for autonomy is linked with the teachers' use of engaging messages. Specifically, teachers who feel that their need for autonomy is fulfilled are more likely to be perceived as belonging to the active profile rather than to the passive profile. Similarly, when teachers feel their need for autonomy is thwarted, students are more likely to perceive their teacher to rely on the engaging messages illustrated by the passive profile rather than those of the active profile. These findings add significantly to the existing evidence on the relation between the inner and outer sides of teachers. Precisely, that teachers' needs are related to their teaching behaviour (i.e., engaging messages).

Following the self-determination theory (Deci & Ryan, 2008; Ryan & Deci, 2020), the fulfilment of the basic psychological needs is essential for an optimal functioning. Among these needs, the

Table 6  
Odd ratios of the association between basic psychological needs and engaging messages at L2.

| Basic Psychological Need | Fulfilment |          |      |                | Thwarting |          |      |                |
|--------------------------|------------|----------|------|----------------|-----------|----------|------|----------------|
|                          | OR         | <i>b</i> | SE   | <i>P</i> value | OR        | <i>b</i> | SE   | <i>P</i> value |
| Autonomy                 | 4.129      | 1.418    | .619 | .022           | .322      | -1.132   | .449 | .012           |
| Relatedness              | .441       | -.819    | .821 | .318           | .568      | -.566    | .837 | .499           |
| Competence               | 1.303      | .265     | .557 | .634           | 1.302     | .264     | .324 | .416           |

Note. OR = odd ratio; *b* = logistic regression coefficient; SE = standard error.



authors of the theory postulate that autonomy plays the most important role (Deci & Ryan, 2000). Thus, the present findings line up with the theory as they highlight that when teachers feel their perspectives are considered and their initiatives supported, they are more likely to use messages to involve students in school duties. Following these assumptions, teachers whose need for autonomy is satisfied would find themselves in a professional state of balance and comfort at their workplace. Those teachers are perceived by their students as relying on messages that try to engage them in school tasks and among these messages, relying mostly on gain-framed self-determined appeals. We could argue that fulfilled autonomy promotes teachers to take care for their students and their learning, desiring the best for them and, in turn, making them rely on adequate engaging messages.

On the other hand, when teachers need for autonomy is thwarted, students perceived their teachers as barely relying on messages that try to encourage them to actively participate in the learning process. When teachers' need for autonomy is thwarted it is more likely for them to not feel supported by head teachers, to feel their perspectives are not being taking into consideration and might also feel pressured to comply with meaningless demands. This would translate into teachers not paying heed to their messages, and thus, not relying on any kind of message.

Turning to students' academic performance, results show that teachers in the active profile have students with higher academic performance. In this sense, providing messages that highlight the benefits of engaging in school duties is better for student's academic performance than not relying on this kind of messages. When teachers are communicationally active, namely relying on messages that try to promote engagement, students might feel cared for by their teacher. This feeling could encourage students to think that their teachers sincerely want the best for them, and thus, to engage in their school duties and perform better. Contrastingly, when teachers do not rely on these messages, students could feel unsupported by their teachers which would translate into a lower academic performance.

Together, our findings suggest that when teachers' need for autonomy is satisfied, it is more likely for them to rely on messages that encourage engagement among students, and this kind of messages would be related to higher academic performance. Similarly, when the need for autonomy is thwarted, there is a lower likelihood of teachers relying on this type of engaging style, which would be less beneficial for students' academic performance. In conclusion, teachers' needs relate to their use of engaging messages, and their use of engaging messages relates to students' academic performance.

### 6.3. Limitations and future perspectives

Although the present study makes a significant contribution, some limitations need to be addressed. First, the data collected was cross-sectional, which means that it was collected at a unique period of time. Therefore, it would be worthwhile to conduct longitudinal studies in the future in order to observe if changes in teachers BPNs fulfilment predict changes in their use of engaging messages. Second, part of our data is self-reported (via student and teacher reports) which indicates that variables represent students' and teachers' perceptions. Whereas, teacher self-reports might be an appropriate approach to collect this information, as it is the teacher's own perception what builds their need fulfilment or thwarting, students' self-reports about their teacher's engaging messages may lead to possible bias due to their indirect nature. Consequently, future studies could incorporate a more objective variable such as direct observations inside the classroom to measure teachers' engaging messages. Thirdly, both teachers and

students who participated in this study belonged to the secondary education stage. It would be interesting to carry out a similar study at different educational levels, in order to examine whether the observed trend is replicated. Further research is also needed in order to explore what other variables might influence teachers to rely on certain engaging messages over others. Fourth, some authors consider that, similar to intelligence, basic needs share a global factor (Sánchez-Oliva et al., 2017). To explore how much each need explains above and beyond the other needs and the global factor, it is recommended to test it via a bi-factor ESEM (Gillet et al., 2019). Fifth, future studies could also explore the reasons why some teachers do not rely or rely very little on any kind of message (i.e., teachers are not concern about the students' future or they believe that their teaching behaviour is not related to the students' outcomes). Exploring this key line of research may be instrumental in designing future interventions tailored for this specific profile of teachers.

Finally, it would also be interesting to explore whether interventions based on the present study yield positive results. To improve teaching behaviours it is essential to work with variables amenable to intervention (Hill et al., 2019; Kunter et al., 2013). In this sense, researchers have underlined certain strategies to improve both basic psychological needs (Cheon et al., 2020) and teachers' engaging messages (Santana et al., 2019), which could be implemented as intervention programs. For instance, these interventions could target academic school staff, including teachers, head teachers and department coordinators to teach them what basic psychological needs are and the importance of their fulfilment.

Regarding teachers' engaging messages, there is also a need to explore whether a teacher intervention targeting this teaching behaviour is effective in improving student outcomes. To this end, school-based teaching programs could also be implemented in order to help teachers understand the importance of relying on gain-framed self-determined appeals. The formation could include the different types of messages that can be used by teachers and the different effects they have on students' well-being and academic performance. This would help them understand what engaging messages they should be relying on and why.

## 7. Conclusion

Teaching is a profession that requires a high level of involvement that sometimes results in a great cognitive and emotional strain (Lauermann & König, 2016). The present study helps us understand the influence of teachers' basic psychological needs on their teaching behaviors and adds to our understanding of the relation between teaching behaviors and student outcomes. In contrast with previous studies, the present work contributes to the understanding of the relation between student outcomes and teacher behaviors not only by exploring this relation directly, but also, by exploring the possible reasons for certain teaching behaviors. It is well known that teacher behaviors have a solid link with student outcomes, as demonstrated by previous research and the current one (Collie et al., 2019). However, whilst this relation is strongly supported, teachers' basic psychological needs and their influence on their own teaching behaviour has been poorly addressed (Klassen et al., 2012; Korthagen & Evelein, 2016). In other words, connecting teachers' inner side with their outer side of teaching has not been a focus of interest among researchers until recently.

The present findings highlight the impact of teachers' need fulfilment and thwarting on their engaging messages, and the impact of their engaging messages on students' academic performance, both at the student-level and teacher-level. Furthermore, it

also helps us understand how we can classify teachers according to their use of the different engaging messages. Given these relations, in order to improve teaching behaviors and student outcomes, attending to the teachers' inner side should be a priority. Schools that provide a context where the three basic psychological needs are satisfied have proven to positively influence teaching behaviour and teachers' well-being (Lee & Nie, 2014). In contrast, school contexts that undermine these needs prevent highly motivated and skilled teachers from performing effective teaching behaviors (Leithwood & Jantzi, 2006). Therefore, taking into consideration the difficult and slow pace that changes at political levels have, actions can and should be taken effectively at the school level, as proven previously (Ebersold et al., 2019).

### Authors contributions

Elisa Santana-Monagas: Investigation, Data curation, Project administration, Writing – original draft, Writing – review & editing; Juan L. Núñez: Writing – review & editing, Supervision; Juan F. Loro: Writing – review & editing, Supervision; Elisa Huéscar: Writing – review & editing; Jaime León: Conceptualization, Methodology, Formal analysis, Project administration, Funding acquisition, Writing – review & editing.

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### Declaration of competing interest

None.

### References

- Asparouhov, T., & Muthén, B. O. (2014a). Auxiliary variables in mixture modeling: Three-step approaches using Mplus. *Structural Equation Modeling: A Multidisciplinary Journal*, 21(3), 329–341. <https://doi.org/10.1080/10705511.2014.915181>
- Asparouhov, T., & Muthén, B. O. (2014b). Auxiliary variables in mixture modeling: Using the BCH method in Mplus to estimate a distal outcome model and an arbitrary second model. In *Mplus web notes*. Retrieved from [https://www.statmodel.com/download/asparouhov\\_muthen\\_2014.pdf](https://www.statmodel.com/download/asparouhov_muthen_2014.pdf).
- Bandura, A. (1978). The self system in reciprocal determinism. *American Psychologist*, 33(4), 344–358. <https://doi.org/10.1037/0003-066X.33.4.344>
- Bartholomew, K. J., Ntoumanis, N., Mouratidis, A., Katartzi, E., Thøgersen-Ntoumani, C., & Vlachopoulos, S. (2018). Beware of your teaching style: A school-year long investigation of controlling teaching and student motivational experiences. *Learning and Instruction*, 53, 50–63. <https://doi.org/10.1016/j.learninstruc.2017.07.006>
- Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin*, 37(11), 1459–1473. <https://doi.org/10.1177/0146167211413125>
- Behzadnia, B., Adachi, P. J. C., Deci, E. L., & Mohammadzadeh, H. (2018). Associations between students' perceptions of physical education teachers' interpersonal styles and students' wellness, knowledge, performance, and intentions to persist at physical activity: A self-determination theory approach. *Psychology of Sport and Exercise*, 39, 10–19. <https://doi.org/10.1016/j.psychsport.2018.07.003>
- Blazar, D., & Kraft, M. A. (2017). Teacher and teaching effects on students' attitudes and behaviors. *Educational Evaluation and Policy Analysis*, 39(1), 146–170. <https://doi.org/10.3102/0162373716670260>
- Bolck, A., Croon, M., & Hagenaars, J. (2004). Estimating latent structure models with categorical variables: One-step versus three-step estimators. *Political Analysis*, 12(1), 3–27. <https://doi.org/10.1093/pan/mpm001>
- Busemeyer, J. R. (2017). Introduction to special issue on theory integration. *Decision*, 4(3), 131–132. <https://doi.org/10.1037/dec0000084>
- Caldarella, P., Larsen, R. A. A., Williams, L., Downs, K. R., Wills, H. P., & Wehby, J. H. (2020). Effects of teachers' praise-to-reprimand ratios on elementary students'

- on-task behaviour. *Educational Psychology*, 1–17. <https://doi.org/10.1080/01443410.2020.1711872>
- Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., Duriez, B., Lens, W., Matos, L., Mouratidis, A., Ryan, M. R., Sheldon, K. M., Soenens, B., Van Petegem, S., & Verstuyf, J. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, 39(2), 216–236. <https://doi.org/10.1007/s11031-014-9450-1>
- Cheon, S. H., Reeve, J., & Vansteenkiste, M. (2020). When teachers learn how to provide classroom structure in an autonomy-supportive way: Benefits to teachers and their students. *Teaching and Teacher Education*, 90, 103004. <https://doi.org/10.1016/j.tate.2019.103004>
- Chetty, R., Friedman, J. N., & Rockoff, J. E. (2014). Measuring the impacts of teachers II: Teacher value-added and student outcomes in adulthood. *The American Economic Review*, 104(9), 2633–2679. <https://doi.org/10.1257/aer.104.9.2633>
- Collie, R. J., Granziera, H., & Martin, A. J. (2019). Teachers' motivational approach: Links with students' basic psychological need frustration, maladaptive engagement, and academic outcomes. *Teaching and Teacher Education*, 86, 102872. <https://doi.org/10.1016/j.tate.2019.07.002>
- Collie, R. J., Malmberg, L., Martin, A. J., Sammons, P., & Morin, A. J. S. (2020). A multilevel person-centered examination of teachers' workplace demands and resources : Links with work-related well-being. *Frontiers in Psychology*, 11(626), 1–19. <https://doi.org/10.3389/fpsyg.2020.00626>
- Collie, R. J., & Martin, A. J. (2017). Teachers' sense of adaptability: Examining links with perceived autonomy support, teachers' psychological functioning, and students' numeracy achievement. *Learning and Individual Differences*, 55, 29–39. <https://doi.org/10.1016/j.lindif.2017.03.003>
- Cuevas, R., Sánchez-Oliva, D., Bartholomew, K. J., Ntoumanis, N., & García-Calvo, T. (2015). Adaptation and validation of the psychological need thwarting scale in Spanish physical education teachers. *Spanish Journal of Psychology*, 18, 1–9. <https://doi.org/10.1017/sjp.2015.56>
- Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 37–41. <https://doi.org/10.1207/S15327965PLI1104>
- Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology*, 49(1), 14–23. <https://doi.org/10.1037/0708-5591.49.1.14>
- Deci, E. L., & Ryan, R. M. (2016). Optimizing students' motivation in the era of testing and pressure: A self-determination theory perspective. In W. C. Liu, J. C. K. Wang, & R. M. Ryan (Eds.), *Building autonomous learners* (pp. 9–29). Singapore: Springer.
- Ebersold, S., Rahm, T., & Heise, E. (2019). Autonomy support and well-being in teachers: Differential mediations through basic psychological need satisfaction and frustration. *Social Psychology of Education*, 22(4), 921–942. <https://doi.org/10.1007/s11218-019-09499-1>
- Froiland, J. M., & Worrell, F. C. (2016). Intrinsic motivation, learning goals, engagement, and achievement in a diverse high school. *Psychology in the Schools*, 53(3), 321–336. <https://doi.org/10.1002/pits.21901>
- Gigerenzer, G. (2017). A theory integration program. *Decision*, 4(3), 133–145. <https://doi.org/10.1037/dec0000082>
- Gillet, N., Morin, A. J. S., Huart, I., Colombat, P., & Fouquereau, E. (2019). The forest and the trees: Investigating the globality and specificity of employees' basic need satisfaction at work. *Journal of Personality Assessment*, 1–12. <https://doi.org/10.1080/00223891.2019.1591426>, 0(0).
- Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of Sport and Exercise*, 16, 26–36. <https://doi.org/10.1016/j.psychsport.2014.08.013>
- Haerens, L., Vansteenkiste, M., De Meester, A., Delrue, J., Tallir, I., Vande Broek, G., Goris, W., & Aelterman, N. (2018). Different combinations of perceived autonomy support and control: Identifying the most optimal motivating style. *Physical Education and Sport Pedagogy*, 23(1), 16–36. <https://doi.org/10.1080/17408989.2017.1346070>
- Hancock, G. R., & An, J. (2020). A closed-form alternative for estimating  $\omega$  reliability under unidimensionality. *18(1)*, 1–14. <https://doi.org/10.1080/15366367.2019.1656049>
- Hill, H. C., Charalambous, C. Y., & Chin, M. J. (2019). Teacher characteristics and student learning in mathematics: A comprehensive assessment. *Educational Policy*, 33(7), 1103–1134. <https://doi.org/10.1177/0895904818755468>
- Jang, H., Joo, E., & Reeve, J. (2016). Why students become more engaged or more disengaged during the semester: A self-determination theory dual-process model. *Learning and Instruction*, 43, 27–38. <https://doi.org/10.1016/j.learninstruc.2016.01.002>
- Justice, L. M., Petscher, Y., Schatschneider, C., & Mashburn, A. (2011). Peer effects in preschool classrooms: Is children's language growth associated with their classmates' skills? *Child Development*, 82(6), 1768–1777. <https://doi.org/10.1111/j.1467-8624.2011.01665.x>
- Klaeijns, A., Vermeulen, M., & Martens, R. (2018). Teachers' innovative behaviour: The importance of basic psychological need satisfaction, intrinsic motivation, and occupational self-efficacy. *Scandinavian Journal of Educational Research*, 62(5), 769–782. <https://doi.org/10.1080/00313831.2017.1306803>
- Klassen, R. M., Perry, N. E., & Frenzel, A. C. (2012). Teachers' relatedness with students: An underemphasized component of teachers' basic psychological needs. *Journal of Educational Psychology*, 104(1), 150–165. <https://doi.org/10.1037/a0026253>

- Korpipää, H., Moll, K., Aunola, K., Tolvanen, A., Koponen, T., Aro, M., & Lerikainen, M.-K. (2019). Early cognitive profiles predicting reading and arithmetic skills in grades 1 and 7. *Contemporary Educational Psychology*, 60. <https://doi.org/10.1016/j.cedpsych.2019.101830>
- Korthagen, F. A. J., & Evelein, F. G. (2016). Relations between student teachers' basic needs fulfillment and their teaching behavior. *Teaching and Teacher Education*, 60, 234–244. <https://doi.org/10.1016/j.tate.2016.08.021>
- Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology*, 105(3), 805–820. <https://doi.org/10.1037/a0032583>
- Lanza, S. T., & Rhoades, B. L. (2013). Latent class analysis: An alternative perspective on subgroup analysis in prevention and treatment. *Prevention Science*, 14(2), 157–168. <https://doi.org/10.1007/s11211-011-0201-1>
- Lauermann, F., & König, J. (2016). Teachers' professional competence and wellbeing: Understanding the links between general pedagogical knowledge, self-efficacy and burnout. *Learning and Instruction*, 45, 9–19. <https://doi.org/10.1016/j.learninstruc.2016.06.006>
- Lazarides, R., Gaspard, H., & Dicke, A. (2019). Dynamics of classroom motivation: Teacher enthusiasm and the development of math interest and teacher support. *Learning and Instruction*, 60, 126–137. <https://doi.org/10.1016/j.learninstruc.2018.01.012>
- Lee, A. N., & Nie, Y. (2014). Understanding teacher empowerment: Teachers' perceptions of principal's and immediate supervisor's empowering behaviours, psychological empowerment and work-related outcomes. *Teaching and Teacher Education*, 41, 67–79. <https://doi.org/10.1016/j.tate.2014.03.006>
- Leithwood, K., & Jantzi, D. (2006). Transformational school leadership for large-scale reform: Effects on students, teachers, and their classroom practices. *School Effectiveness and School Improvement*, 17(2), 201–227. <https://doi.org/10.1080/09243450600565829>
- León, J., Medina-Garrido, E., & Núñez, J. L. (2017). Teaching quality in math class: The development of a scale and the analysis of its relationship with engagement and achievement. *Frontiers in Psychology*, 8, 1–14. <https://doi.org/10.3389/fpsyg.2017.00895>
- León, J., Medina-Garrido, E., & Ortega, M. (2018). Teaching quality: High school students' autonomy and competence. *Psicothema*, 30(2), 218–223. <https://doi.org/10.7334/psicothema2017.23>
- León, J., Santana, E., Loro, J. F., & Núñez, J. L. (2019). How can teachers encourage stage study? Preliminary validation of an assessment tool for messages in the classroom. In *I Congreso Internacional de Educación e Intervención: Psicoeducativa, Familiar y Social* (Vol. 262).
- Liga, F., Ingoglia, S., Cuzzocrea, F., Inguglia, C., Costa, S., Lo Coco, A., & Larcan, R. (2018). The basic psychological need satisfaction and frustration scale: Construct and predictive validity in the Italian context. *Journal of Personality Assessment*, 1–11. <https://doi.org/10.1080/00223891.2018.1504053>, 0(0).
- Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika*, 88(3), 767–778. <https://doi.org/10.1093/biomet/88.3.767>
- Mäkikangas, A., Tolvanen, A., Aunola, K., Feldt, T., Mauno, S., & Kinnunen, U. (2018). Multilevel latent profile analysis with covariates: Identifying job characteristics profiles in hierarchical data as an example. *Organizational Research Methods*, 21(4), 931–954. <https://doi.org/10.1177/1094428118760690>
- Marshik, T., Ashton, P. T., & Algina, J. (2017). Teachers' and students' needs for autonomy, competence, and relatedness as predictors of students' achievement. *Social Psychology of Education*, 20(1), 39–67. <https://doi.org/10.1007/s11218-016-9360-z>
- Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Morin, A. J. S., Abduljabbar, A. S., & Köller, O. (2012). Classroom climate and contextual effects: Conceptual and methodological issues in the evaluation of group-level effects. *Educational Psychologist*, 47(2), 106–124. <https://doi.org/10.1080/00461520.2012.670488>
- Marsh, H. W., Lüdtke, O., Trautwein, U., & Morin, A. J. S. (2009). Classical latent profile analysis of academic self-concept dimensions: Synergy of person- and variable-centered approaches to theoretical models of self-concept. *Structural Equation Modeling: A Multidisciplinary Journal*, 16(2), 191–225. <https://doi.org/10.1080/10705510902751010>
- Martinek, D. (2019). The consequences of job-related pressure for self-determined teaching. *Social Psychology of Education*, 22(1), 133–148. <https://doi.org/10.1007/s11218-018-9446-x>
- McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*, 23(3), 412–433. <https://doi.org/10.1037/met0000144>
- Morin, A. J. S., & Marsh, H. W. (2015). Disentangling shape from level effects in person-centered analyses: An illustration based on university teachers' multidimensional profiles of effectiveness. *Structural Equation Modeling: A Multidisciplinary Journal*, 22(1), 39–59. <https://doi.org/10.1080/10705511.2014.919825>
- Morin, A. J. S., Marsh, H. W., Nagengast, B., & Scalas, L. F. (2014). Doubly latent multilevel analyses of classroom climate: An illustration. *The Journal of Experimental Education*, 82(2), 143–167. <https://doi.org/10.1080/00220973.2013.769412>
- Morin, A. J. S., Meyer, J. P., Creusier, J., & Biétry, F. (2016). Multiple-group analysis of similarity in latent profile solutions. *Organizational Research Methods*, 19(2), 231–254. <https://doi.org/10.1177/1094428115621148>
- Muthén, L. K., & Muthén, B. O. (2021). *Mplus user's guide* (8th ed.). Muthén & Muthén.
- Ntoumanis, N., Quested, E., Reeve, J., & Cheon, S. H. (2017). Need-supportive communication: Implications for motivation in sport, exercise, and physical activity. In *Persuasion and communication in sport, exercise, and physical activity* (pp. 155–169). <https://doi.org/10.4324/9781315624365>. Issue December.
- Núñez, J. L., & León, J. (2015). Autonomy support in the classroom: A review from self-determination theory. *European Psychologist*, 20(4), 275–283. <https://doi.org/10.1027/1016-9040/a000234>
- Pelletier, L. G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology*, 94(1), 186–196. <https://doi.org/10.1037/0022-0663.94.1.186>
- Praetorius, A. K., Lauermann, F., Klassen, R. M., Dickhäuser, O., Janke, S., & Dresel, M. (2017). Longitudinal relations between teaching-related motivations and student-reported teaching quality. *Teaching and Teacher Education*, 65, 241–254. <https://doi.org/10.1016/j.tate.2017.03.023>
- Putwain, D. W., & Remedios, R. (2014). The scare tactic: Do fear appeals predict motivation and exam scores? *School Psychology Quarterly*, 29(4), 503–516. <https://doi.org/10.1037/spq0000048>
- Putwain, D. W., & Roberts, C. M. (2009). The development of an instrument to measure teachers' use of fear appeals in the GCSE classroom. *British Journal of Educational Psychology*, 79(4), 643–661. <https://doi.org/10.1348/000709909X426130>
- Putwain, D. W., & Symes, W. (2016). Expectancy of success, subjective task-value, and message frame in the appraisal of value-promoting messages made prior to a high-stakes examination. *Social Psychology of Education*, 1–19. <https://doi.org/10.1007/s11218-016-9337-y>
- Putwain, D. W., Symes, W., & Wilkinson, H. M. (2017). Fear appeals, engagement, and examination performance: The role of challenge and threat appraisals. *British Journal of Educational Psychology*, 87(1), 16–31. <https://doi.org/10.1111/bjep.12132>
- Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, 44(3), 159–175. <https://doi.org/10.1080/00461520903028990>
- Rothman, A. J., & Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychological Bulletin*, 121(1), 3–19.
- Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78. <https://doi.org/10.1037/0003-066X.55.1.68>
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. New York, NY: The Guilford Press.
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>
- Sánchez-Oliva, D., Morin, A. J. S., Teixeira, P. J., Carraça, E. V., Palmeira, A. L., & Silva, M. N. (2017). A bifactor exploratory structural equation modeling representation of the structure of the Basic Psychological Needs at Work Scale. *Journal of Vocational Behavior*, 98, 173–187. <https://doi.org/10.1016/j.jvb.2016.12.001>
- Sánchez-Pérez, N., Fuentes, L. J., Pina, V., López-López, J. A., & González-Salinas, C. (2015). How do different components of effortful control contribute to children's mathematics achievement? *Frontiers in Psychology*, 5(415). <https://doi.org/10.3389/fpsyg.2015.01383>
- Santana, E., Fitzpatrick, I., Núñez, J. L., León, J., & Loro, J. F. (2019). Perfiles según el estilo comunicativo de los profesores de educación secundaria [Communicative style profiles of middle-school teachers]. In *XIX congreso internacional de Investigación educativa* (pp. 238–244).
- Sevil, J., Aibar, A., Abós, Á., & García, L. (2017). Motivational climate of teaching physical education: Could it affect student grades? *Retos. Nuevas Tendencias En Educación Física, Deportes y Recreación*, 31, 98–102.
- Shen, B., McCaughy, N., Martin, J., Garn, A., Kulik, N., & Fahlman, M. (2015). The relationship between teacher burnout and student motivation. *British Journal of Educational Psychology*, 85(4), 519–532. <https://doi.org/10.1111/bjep.1208>
- Stanley, L., Kellermanns, F. W., & Zellweger, T. M. (2017). Latent profile analysis: Understanding family firm profiles. *Family Business Review*, 30(1), 84–102. <https://doi.org/10.1177/0894486516677426>
- Symes, W., & Putwain, D. W. (2016). The role of attainment value, academic self-efficacy, and message frame in the appraisal of value-promoting messages. *British Journal of Educational Psychology*, 86(3), 446–460. <https://doi.org/10.1111/bjep.12117>
- Van den Berghe, L., Soenens, B., Aelterman, N., Cardon, G., Tallir, I. B., & Haerens, L. (2014). Within-person profiles of teachers' motivation to teach: Associations with need satisfaction at work, need-supportive teaching, and burnout. *Psychology of Sport and Exercise*, 15(4), 407–417. <https://doi.org/10.1016/j.psychsport.2014.04.001>
- Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, 23(3), 263–280. <https://doi.org/10.1037/a003235>
- Vansteenkiste, M., Sierens, E., Goossens, L., Soenens, B., Dochy, F., Mouratidis, A., Aelterman, N., Haerens, L., & Beyers, W. (2012). Identifying configurations of perceived teacher autonomy support and structure: Associations with self-regulated learning, motivation and problem behavior. *Learning and Instruction*, 22(6), 431–439. <https://doi.org/10.1016/j.learninstruc.2012.04.002>
- Wooldridge, J. M. (2020). *Introductory econometrics: A modern approach* (7th ed.). Cengage Learning.