



The relationship among students' and teachers' thinking styles, psychological needs and motivation



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ABSTRACT

This study examines the relationship among students' and teachers' thinking styles, student psychological needs (autonomy, competence and relatedness), and their reports of intrinsic motivation in the Psychology Degree context. The sample comprised 266 Spanish undergraduate students. Spanish adapted version scales were used to assess the constructs considered in this study. The original scales were created based on the mental self-government and the Self-Determination Theories. Structural equation analyses reveal that the teachers' and students' Type I thinking styles have a significant and positive impact on student psychological need satisfaction, whereas students' and the teachers' Type II thinking styles have a significant and negative impact. In turn, psychological need satisfaction has a significant and positive impact on student intrinsic motivation. Implications for instructional practice are discussed.

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1. Introduction

This study examines, from a retrospective viewpoint, the relationship among students' and teachers' thinking styles, their interaction, student psychological need satisfaction (autonomy, competence and relatedness) and their reports of intrinsic motivation (“IM to know”, “IM to accomplish” and “IM to experience stimulation”) in Spanish undergraduate psychology students. Previous research based on the Self-Determination Theory (SDT) has provided considerable evidence of how psychological needs directly impact well-being and motivation (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Elliot, Kim, & Kasser, 2001; Sheldon, Ryan, & Reis, 1996). However, studies which focus on examining the relationship among thinking styles, students' psychological needs and intrinsic motivation in a specific university degree are scarce. This study may provide guidelines to explain how student basic needs can be satisfied and how intrinsic motivation can be improved, and can help build bridges between different Educational Psychology domains.

1.1. Thinking styles

Individual differences have always aroused much interest in Educational Psychology. In current cognitive psychology, research mainly focuses on cognitive differences, such as thinking styles. In

recent years, increasing attention has been paid to thinking styles. Researchers have found that thinking styles have implications for teaching and learning (see Grigorenko & Sternberg, 1997; Sternberg, 1997; Zhang & Sternberg, 2001). Sternberg (1997) proposed his theory of “mental self-government” to introduce the thinking style concept. Sternberg used the metaphor “mental self-government” to portray the way the human mind works. Just as there are many ways of governing our society, there are also many ways of governing our intelligence. Sternberg (1997) calls the different ways our intelligence is governed by “thinking styles”. Sternberg (1993, 1994) proposed 13 thinking styles grouped together in five dimensions: function (legislative, executive and judicial), form (hierarchical, oligarchic, monarchic and anarchic), level (global and local), scope (internal and external) and leaning (liberal and conservative). According to Sternberg (1997), a thinking style is not an aptitude, rather the way one chooses to use one's aptitudes. Thinking style refers to what a person prefers to do, and how they like to do it. Although thinking styles fall into five dimensions, they can be broadly categorized into three groups (Zhang, 2004a,c). The first group, known as Type 1 (legislative, judicial, hierarchical, global, and liberal styles), is composed of thinking styles that are more creativity generating and they denote higher levels of cognitive complexity. The second group, known as Type 2 (executive, local, monarchic and conservative styles), involves ways of doing things that are more norm-favoring and more simplistic. The remaining four thinking styles (i.e., anarchic, oligarchic, internal and external) have been labeled Type 3. Styles belonging to Type 3 “may manifest the characteristics of the styles from both groups, depending on the stylistic demand of the specific task” (Zhang, 2004a, p. 235). According to previous research on thinking styles (reviewed by Zhang, 2002b, 2004a), The Type 1 styles generally correlate positively with human

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attributes that are traditionally perceived as positive (e.g., deep approach to learning, higher cognitive developmental levels, holistic mode of thinking, the openness personality trait). Conversely, the Type 2 thinking styles have, in general, been significantly correlated with human attributes that are traditionally considered negative (e.g., lower self-esteem, lower cognitive developmental levels, analytic mode of thinking, and the neuroticism personality trait). Furthermore, Zhang (2004c) claims that “teachers who reported a conceptual change/student-focused teaching approach tended to use the Type 1 teaching styles, and that teachers who reported a knowledge transmission/teacher-focused teaching approach tended to use Type 2” (p. 1553). Thus, one can infer that the teacher methodology reflects the underlying thinking styles.

The mental self-government theory has been operationalized through several inventories which have been tested in cross-cultural contexts. Apart from obtaining satisfactory reliability and validity data on these measures, some authors have reported interesting findings with implications for teaching and learning (see Grigorenko & Sternberg, 1997; Sternberg, 1997; Zhang, 2008; Zhang & Sternberg, 2001).

To date, the studies done in this field have examined the relationship between thinking styles and achievement (e.g., Cano-García & Hughes, 2000; Grigorenko & Sternberg, 1997; Zhang, 2002b, 2004b; Zhang & Sternberg, 1998), thinking styles and learning approach (Zhang & Sternberg, 2000), thinking styles and students' socio-economic status (Sternberg & Grigorenko, 1995), and thinking styles and personality trait (Zhang, 2002a,b). However, studies that center on the relationship between thinking styles and student motivation are scarce.

Sternberg (1997) gives rise to two fundamental principles: first, schools and other institutions value certain forms of thinking more than others; second, individuals whose ways of thinking do not coincide with the style most appreciated or valued by the institution are usually penalized. That is, “thinking styles are, in principle, value-free, for the same thinking style can serve on person beautifully in one situation, but may fail the same person miserably in another situation” (Zhang, 2004c, p. 1552). If we apply this notion to the classroom context, we can infer that students will be more at ease and effective when their predominant thinking styles that they use to learn fit well and are compatible with the way the class is organized and conducted (learning environment); that is, with the thinking style/s used by the teachers to teach.

In operational terms, this means that there must be an interactive relationship between the teachers' thinking styles and students' thinking styles, where the effect and efficacy of the thinking style used by teachers to teach may be moderated by the level of the homologous thinking style used by students to learn. Based on this rationale, and specifically for the current study, it is expected that students will feel more self-determined and, consequently, more motivated, to the extent that the predominant thinking style that they use to learn is similar or compatible with the predominant one used by teachers to teach; vice versa, students will feel less self-determined and, consequently, less motivated, to the extent that the predominant thinking style they use to learn is unsuitable or incompatible with the predominant one used by teachers to teach.

1.2. Psychological needs

Deci and Ryan's (1985, 2000) Self-Determination Theory (SDT) is an organismic theory of optimal human motivation, which has been extensively supported by a number of studies in the field of education, particularly at the primary and secondary school levels, in the last three decades (Ryan & Stiller, 1991; Sheldon & Biddle, 1998). According to the SDT, three basic psychological needs (autonomy, competence, and relatedness) undermine or support peoples' intrinsic motivation to engage in a given behavior.

Autonomy occurs when people feel they are the cause of their behavior (Deci & Ryan, 1985). “Autonomy is not independence or total

freedom, rather an internal acceptance of, and engagement with, one's motivated behavior. Supporting autonomy means taking the student's perspective, providing choice, and providing a meaningful rationale when choice is not possible” (Filak & Sheldon, 2003, p. 235). Competence occurs when one feels effective in one's behavior. Competence comes close to self-efficacy and it can be seen when one takes on and masters challenging tasks. “Supporting competence means conveying confidence in students' ability to surmount challenges, and provides sensitive mentoring and feedback” (Filak & Sheldon, 2003, p. 237). Relatedness occurs when one feels connected to, or understood by, others. This construct is similar to the need for belongingness posited by Baumeister and Leary (1995), but is more general and includes both interpersonal and group connections (Filak & Sheldon, 2003). Supporting relatedness means providing acceptance, respect and the feeling of caring.

According to the SDT, when these three needs are satisfied, they encourage psychological well-being and enable students to achieve optimal academic performance. In contrast, when these needs are not satisfied, students fail to thrive. Previous research (Reis et al., 2000; Sheldon et al., 1996, 2001) has not only provided empirical evidence for these assumptions, but has also proved the positive effect of psychological need satisfaction and achievement (Black & Deci, 2000). However, studies which focus on examining the relationship between students' psychological needs and achievement in specific subject matter domains are scarce.

1.3. Intrinsic motivation

Research studies on student motivation have received increased attention in the past decade (Murphy & Alexander, 2000; Pintrich, 2000). Different theories have been applied to studies on motivation, and among them, we wish to highlight the Self-Determination Theory (SDT). Previous research indicates that when people are self-determined, they show greater initiative and persistence (Deci & Ryan, 1987), feel more satisfaction and trust (Deci, Connell, & Ryan, 1989), perceive themselves as exercising more decision-making control, and take more responsibility for the outcomes of one event (Deci & Ryan, 1985). According to the SDT, behavior is either intrinsically or extrinsically motivated or amotivated. These dimensions are placed on a continuum ranging from lack of control to self-determined behavior (Deci & Ryan, 1985, 1991). The SDT emphasizes the assumption that intrinsic need satisfaction is more important to learn than extrinsic need satisfaction. A number of studies have demonstrated the innumerable advantages of intrinsic motivation in the learning context. Thus when students are intrinsically motivated, learning is more significant and successful (Reeve, Deci, & Ryan, 2004; Reeve, Ryan, Deci, & Jang, 2008), and students tend to achieve better academic achievement (e.g., Areepattamannil & Freeman, 2008; Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007). Moreover, Deci and Ryan (1985) stated that when people are intrinsically motivated, they engage in activities that interest them with a full sense of volition without the need for material rewards or constraints.

Ryan and Deci (2000) defined intrinsic motivation (IM) as “the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn” (p. 70). In order to complete this definition, it is worth citing a paragraph written by Ryan and Deci (2002): “Intrinsically motivated behaviors are those whose motivation is based on the inherent satisfactions of behaviors per se, rather than on contingencies or reinforcements that are operationally separable from those activities.” (p. 10).

The IM construct is made up of three components: IM to know, IM to accomplish and IM to experience stimulation (Vallerand et al., 1992). IM to know has been related to concepts such as curiosity and motivation to learn (Gottfried, 1985), and refers to carrying out an activity for the pleasure that someone experiences while learning, exploring, or when someone is trying to understand something new (Vallerand et al.,

1992). IM to accomplish can be defined as engagement in an activity for the pleasure and satisfaction that someone experiences when trying to overcome it or reach a new level. Finally, IM to experience stimulation occurs when someone engages in an activity for the fun of it, or to feel positive and stimulating sensations deriving from his or her own dedication to that activity (Vallerand et al., 1992). According to the SDT, fulfilling the three basic psychological needs, perceived autonomy, perceived competence and perceived social relations, encourages IM (Ryan & Deci, 2002).

1.4. Objectives and hypothesis

The aim of this study was to examine the relationship among teachers' and students' thinking styles, psychological needs and intrinsic motivation from the veteran student's perspective. This relationship was examined with participants who had already studied the subject matters for their Psychology Degree in previous courses and semesters.

Based on the above discussion, the hypothesized connections were addressed and tested according to the Structural Equation Modeling (SEM) Procedure.

First, students' psychological need is expected to be a good predictor of intrinsic motivation (IM). It is hypothesized that student psychological need satisfaction is positively and significantly related to intrinsic motivation. According to the SDT, when students perceive that their psychological needs are satisfied, their intrinsic motivation increases. Intrinsic motivation "is manifested as curiosity and interest, which motivate task engagement even in the absence of outside reinforcement or support..." (Ryan, Connell, & Grolnick, 1992, p.170). Consequently, students are more interested and involved in their learning process.

Second, students' perceptions of teachers' thinking styles are expected to be good predictors of student psychological needs. It is hypothesized that the Type I teachers' thinking styles (Legislative, Judicial and Liberal) positively and significantly relate to student psychological needs, whereas the Type II teachers' thinking styles (executive and conservative) negatively and significantly relate to student psychological needs.

Third, according to Sternberg (1997), students' thinking styles are expected to moderate the effect of teachers' thinking styles on student psychological needs. In other words, the effect of teachers' thinking styles may differ at the various levels of homologous students' thinking styles. Therefore, interactions between the paired teachers' and students' thinking styles must be taken into account.

All these predictions were tested simultaneously in two separate structural models: (a) considering teachers' thinking styles as independent-exogenous variables (M1); (b) considering interactions between teachers' and students' thinking styles as independent-exogenous variables (M2). Given that this research work is a cross-sectional study, it is risky to assume causality only in one specific direction. However, hypothesized relationships are well supported by the theory, as explained in the [Introduction](#) section.

2. Method

2.1. Participants and procedure

The sample was made up of 266 instructional psychology students, of whom 214 were female (80.8%) and 51 were male (19.2%), and they were aged between 20 and 47 years (M: 22.6, SD: 3.37). The participants studied Instructional Psychology during the 2010–11 and 2011–12 academic years at the Universitat Jaume I, Castellón (East Spain). Instructional Psychology (IP) is an annual core subject taught in the third academic year of the Psychology Degree. Hence, students were all in the third academic year and the research was conducted over 2 years with the same classes (subject, lecturers, and methodology).

Questionnaires were administered during one IP lecture at the end of the second semester of the third academic year, and were collected by the authors. IP students were asked to think over and evaluate the

construct selected from a retrospective viewpoint; that is, in the subject matters that they had already studied for their Psychology Degree in previous courses and semesters (i.e., first and second academic years, and the first semester of the third academic year). Participants were requested to answer all the items on the scales anonymously. Before completing the questionnaire, verbal information about the research work was provided, doubts were clarified and students were encouraged to think over the subjects that they had already studied for their Psychology Degree in previous academic years and semesters. All the students in the classroom volunteered to complete the questionnaire.

2.2. Measures

The scales listed below were used to collect information from students on the study variables considered in the present work. The original scales were translated into Spanish following the cross-cultural translation procedures (Núñez-Alonso, Martín-Albo, & Navarro, 2005). First, the scale was translated from English into Spanish according to the *parallel back-translation* procedure (Brislin, 1986). Afterward, another bilingual individual, who was not familiar with the original scale, translated this version back to the original language. Second, items were assessed and those that maintained the original meaning were selected.

2.2.1. Teachers' thinking styles (25 items)

All the participants responded to a Spanish version for university students of the Thinking Styles Inventory, adapted by Doménech (2007) from Sternberg (1997). Participants were asked to think over and evaluate teachers' thinking styles used to teach the subject matters that they had already studied in their Psychology Degree in previous academic years and semesters. Only five subscales of the whole questionnaire were used in this study to measure the five teachers' thinking styles: Legislative (5 items), Executive (5 items), Judicial (5 items), Liberal (5 items) and Conservative (5 items). The selected scales were considered the most appropriate to evaluate teachers' thinking styles from a retrospective viewpoint. Participants indicated their level of agreement for each statement on a 5-point Likert scale: 1. Affirmative for all the subjects or for almost all of them (80–100%), 2. Affirmative for most of them (60–80%), 3. Affirmative for about a half (40–60%), 4. Affirmative for a few of them (20–40%), 5. Affirmative for very few or none of them (0–20%).

An exploratory factor analysis (principal component method with varimax rotation) was conducted on the whole scale composed of 25 items. Five factors were extracted which corresponded to the five teachers' thinking styles selected, and they explained 62.83% of variance: F1: Executive (5 items, $\alpha = 0.89$), F2: Liberal (5 items, $\alpha = 0.84$), F3: Judicial (5 items, $\alpha = 0.84$), F4: Legislative (5 items, $\alpha = 0.77$), and F5: Conservative (5 items, $\alpha = 0.80$).

Subsequently, a confirmatory factorial analysis (CFA) was conducted with the Structural Equations Program (EQS) (Bentler, 2006) using the maximum likelihood (ML) method of estimation. The results reveal satisfactory fit indices (Chi-Square = 512.265; D.F. = 265; NFI = .85; NNFI = .91; CFI = .92; RMSEA = .060). The factor loading obtained for each item was statistically significant with most standardized values greater than .50.

A style measure was constructed by averaging the items included in each style factor. For some examples of the items for each style, see [Table 1](#).

2.2.2. Students' thinking styles (25 items)

All the participants responded to a Spanish version for university students of the Thinking Styles Inventory, adapted by Doménech (2007) from Sternberg (1997). Students were requested to think over and evaluate the thinking style they applied to learn the subject matters that they had already studied for their Psychology Degree in previous academic years and semesters. Only five subscales of the whole

Table 1
Structure and examples of the thinking style inventory used for students and teachers.

Thinking style	Students' thinking styles	Teacher's thinking styles
Legislative	1. I feel more comfortable with a task or assignment when I can decide for myself what to do and how to do it.	1. The tasks set by the psychology teachers are sufficiently open and flexible for me to be able to take my own decisions about what to do and how to do it.
Executive	6. I like projects/tasks with a clear structure and a previously established aim and plan.	6. When the psychology teachers set a project or task, he or she clearly indicates its structure, objective, and the plan established for it to be carried out.
Judicial	12. I like to evaluate and criticize the way other students do academic tasks.	12. The psychology teacher encourages students to openly evaluate and criticize the way the teacher does things.
Liberal	18. I like tasks to be novel and creative	18. Psychology teachers encourage novel and creative tasks.
Conservative	24. I prefer to do those tasks and assignments where I need to use already known strategies or techniques.	24. Psychology teachers encourage students to do tasks and assignments that are familiar to them.

questionnaire were used in this study to measure five students' thinking styles (the same measures that were used for teachers): Legislative (5 items), Executive (5 items), Judicial (5 items), Liberal (5 items) and Conservative (5 items). Participants indicated their level of agreement for each statement on a 6-point Likert scale ranging from 1 (*completely false*) to 6 (*completely true*).

A preliminary exploratory factor analysis (principal component method with varimax rotation) was conducted on the whole scale composed of 25 items. Two items were removed to clarify construct interpretation since they presented substantial loadings (.30 or greater) on more than one factor. A second exploratory factor analysis (principal component with varimax rotation) was conducted on the remaining 23 items. Five factors were extracted which corresponded to the five thinking styles selected and explained 67.64% of variance: F1: Liberal (5 items, $\alpha = 0.93$), F2: Conservative (4 items, $\alpha = 0.87$), F3: Judicial (5 items, $\alpha = 0.85$), F4: Legislative (5 items, $\alpha = 0.77$), and Executive (4 items, $\alpha = 0.82$).

Subsequently, a confirmatory factorial analysis (CFA) was conducted with the EQS program (Bentler, 2006) using the maximum likelihood (ML) method of estimation. The results revealed acceptable fit indices when four pairs of covariances between errors of the observed variables were introduced (Chi-Square = 482.297; D.F. = 216; NFI = .87; NNFI = .91; CFI = .92; RMSEA = .068). The factor loading obtained for each item was statistically significant, and all the standardized values were greater than .50.

A style measure was constructed by averaging the items included in each style factor. For some examples of the items for each style, see Table 1

2.2.3. The Basic Psychological Needs Scale (18 items)

This instrument was constructed based on the Basic Psychological Needs Scale developed by Ilardi, Leone, Kasser, and Ryan (1993). The resultant scale comprised three needs (autonomy, competence and relatedness) and was adapted for the Spanish university context in previous studies (Doménech & Gómez, 2011).

An exploratory factor analysis (principal component method with varimax rotation) was conducted on the whole scale composed of 18 items. Three factors were extracted which corresponded to the three needs considered, and explained 63.54% of variance: autonomy (6 items, $\alpha = 0.88$), competence (6 items, $\alpha = 0.83$), relatedness (6 items, $\alpha = 0.85$). Five-point Likert scales were used for each statement, as follows: 1. affirmative for all the subjects or almost all of them (80–100%), 2. affirmative for most of them (60–80%), 3. affirmative for about a half (40–60%), 4. affirmative for a few of them (20–40%), 5. affirmative for a very few or none of them (0–20%).

Subsequently, a CFA was conducted with the EQS program (Bentler, 2006) using the maximum likelihood (ML) method of estimation. The results reveal acceptable fit indices when four pairs of covariances between errors of the observed variables were introduced (Chi-Square = 283.093; D.F. = 126; NFI = .87; NNFI = .92; CFI = .93; RMSEA = .069).

The factor loading obtained for each item was statistically significant with standardized values greater than .50, except for one item. The

average score of all three factors obtained was calculated, where high scores reflected greater need satisfaction perception, and vice versa.

Examples of items for each need are: "In general, I have been free to choose the way I work in the Psychology subject matters given, but with teacher guidance" (*autonomy*), "In general, I have felt competent enough to master the Psychology subject matters given as part of the Psychology Degree" (*Competency*), "In general, the Psychology teacher's attitude has been kind and friendly" (*relatedness*).

2.2.4. The intrinsic motivation scale (12 items)

A measure of motivation toward education was developed in French by Vallerand, Blais, Brière, and Pelletier (1989), namely the *Échelle de Motivation en Éducation* (EME), based on the principles of the SDT. The EME was translated into Spanish and validated (EME-E) by Núñez-Alonso et al. (2005). The EME-E has shown satisfactory levels of internal consistency and temporal stability over a 7-week period. The results of a CFA confirmed the original 7-factor structure.

To assess students' intrinsic motivation to the Psychology Degree, the intrinsic motivation subscale from the Spanish version (EME-R) was used and adapted for the purpose of this study. The intrinsic motivation scale (IM) was made up of three components: IM Knowledge (4 items), IM Achievement (4 items) and IM Stimulant experiences (4 items).

An exploratory factor analysis (principal component method with varimax rotation) was conducted on the IM scale composed of 12 items. Three factors were extracted and corresponded to the three components of the scale and explained 70.02% of variance – IM to knowledge (5 items, $\alpha = 0.89$), IM to achievement (4 items, $\alpha = 0.87$), and IM to stimulant experiences (3 items, $\alpha = 0.73$). Four-point Likert scales were used for each statement, ranging from 1 (I quite disagree) to 4 (I quite agree).

Subsequently, a CFA was conducted with the EQS program (Bentler, 2006). Maximum likelihood with the robust estimation method (Satorra & Bentler, 1988, 1994) was used to calculate fit indices given that the variables are measured on an ordinal scale with relatively few categories (four) and that multivariate normality may be violated. EQS provides a normalized estimate of Mardia's index to detect Multivariate Nonnormality. Bentler and Wu (2002) indicate that a normalized estimate greater than 3 will lead to important standard error and chi-square biases. Since the obtained Mardia's index was 40.89, it seems to suggest that multivariate distribution is nonnormal. The method developed by Satorra and Bentler (1988, 1994) appears to be a good approach to deal with nonnormality data (Curran, West, & Finch, 1996; Hu, Bentler, & Kano, 1992). The results reveal satisfactory fit indices (Chi-Square = 170.502; D.F. = 51; NFI = .87; NNFI = .91; CFI = .93; IFI = .93; MFI = .91; RMSEA = .061). The factor loading obtained for each item was statistically significant, with standardized values greater than .50. The average score of all three factors obtained was calculated, where high scores reflected higher intrinsic motivation, and vice versa.

Examples of items for each component of motivation are: "Because, for me, it is a pleasure and satisfaction to learn new things about Psychology" (*IM to know*), "For the satisfaction I feel when I do well in

my Psychology studies” (*IM to achieve*), “For the intense moments I live when I tell other people about my own ideas about the field of Psychology” (*IM to stimulant experiences*).

In general, exploratory and confirmatory factor analyses confirmed the original structure and configuration of the scales, and the Cronbach's α test showed good alpha reliabilities (0.73 to 0.93). The mean, standard deviation, reliability and structure of the scales are provided in Table 2.

2.3. Data analyses

The hypothesized connections were tested by the Structural Equation Modeling (SEM) Procedure. Before the interactions between the observational variables were tested as predictor variables, the mean centering transformation suggested by Cohen, Cohen, West, and Aiken (2003) was used to reduce multicollinearity. Scores for all the variables used to create the interaction term were centered by subtracting the mean score of each variable from each value of the same variable, thus forming deviation scores and the mean became zero. The results of this procedure were similar to the transformation proposed by Dunlap and Kemery (1987), consisting in standardizing values using z-scores.

Structural equation analyses was conducted in two steps, as suggested by Anderson and Gerbing (1988) and Kline (2005): first, calculating the global fit indices to check the extent to which each model reproduced the relationships in the correlation matrix of the empirical data; and second, analyzing the system of the relationships among the variables considered.

All the models were tested with standardized coefficients, while the fit indices obtained from the maximum likelihood method of estimation were calculated. Since the chi-square test is sensitive to sample size, the use of relative fit indices, such as CFI, NNFI and RMSEA, is strongly recommended (Bentler, 1990). Values lower than .05 for RMSEA indicate a good fit, whereas those up to .08 suggest a poor fit (Browne & Cudeck, 1993). For NNFI and CFI, values greater than .90 suggest a good fit (Hoyle, 1995).

3. Results

3.1. Correlation between variables

As an approach to explore the relationships between the study variables considered, Pearson's bivariate correlations were calculated

(see Table 2). In general, the correlations obtained (see Table 2) were in accordance with our expectations. Hence, significant and positive correlations emerged between the Type I teachers' thinking styles (legislative, judicial and liberal) and students' psychological needs, above all for the need of autonomy (legislative, $r = .567, p < .01$; judicial, $r = .450, p < .01$; liberal, $r = .469, p < .01$). However, significant and negative correlations were obtained between students' psychological needs and the Type II teachers' thinking styles (executive and conservative), particularly, the need of autonomy (executive, $r = -.418, p < .01$; conservative, $r = -.350, p < .01$). The same pattern was also seen between teachers' thinking styles and students' intrinsic motivation, but of lower magnitudes in this case.

Furthermore, significant and positive correlations were seen between students' need satisfaction (autonomy, competence, relatedness and belonging) and two intrinsic motivation components called “IM Knowledge” and “IM Achievement”. However, only the need of competence was seen to positively and significantly correlate with the third component of intrinsic motivation called “IM Stimulant experiences” ($r = .222, p < .001$). Finally, it should be noted that no important correlations were found between either students' thinking styles and psychological needs or students' thinking styles and intrinsic motivation; see Table 3 for more details. Gender was not introduced into this table because no significant correlations were obtained between this variable and the constructs considered.

3.2. Structural equation modeling

The hypothesized connections predicted among the teacher's thinking styles, students' psychological needs and intrinsic motivation were tested (M1). The fit indices values obtained ($\chi^2 = 67.354; p = .0003, D.F. = 33; NFI = 91; NNFI = .92; CFI = .95; GFI = .95; AGFI = .90; RMSEA = .063$) indicate that the model fitted the data well. According to the data, M1 is supported. Structural configuration and standardized coefficients are shown in Fig. 1.

Subsequently, the previous model was extended (M1-E) by grouping the thinking styles into two categories (Type I and Type II), according to Zhang (2004a,b,c), and it was tested again. Specifically, two latent variables were introduced into the previous model, namely Type I (defined by Legislative, Judicial and Liberal styles) and Type II (defined by Executive and Conservative styles). Moreover, the three needs were considered as observational variables. The fit indices values obtained ($\chi^2 = 119.115; p = .0000, D.F. = 34; NFI = 83; NNFI = .76; CFI = .85; GFI = .91; AGFI = .84; RMSEA = .112$) indicate that the model does not fit the data well, therefore, M1-E is not supported.

The hypothesized connections predicted among teachers' and students' thinking styles, students' psychological needs and intrinsic motivation were tested (M2). The fit indices values obtained ($\chi^2 = 55.921; p = .0076, D.F. = 33; NFI = 93; NNFI = .94; CFI = .96; GFI = .96; AGFI = .93; RMSEA = .052$) indicate that the model fits the data well. Structural configuration and standardized coefficients are shown in Fig. 2. According to the data, M2 is supported.

Subsequently, the previous model (M2) was extended (M2-E) by grouping the thinking styles into two categories (Type I and Type II), according to the classification proposed by Zhang (2002b, 2004c), and it was tested again. Specifically, two latent variables were introduced into the previous model, namely Type I (defined by Legislative, Judicial and Liberal styles) and Type II (defined by Executive and Conservative styles). Moreover, the three needs were considered as observational variables. The results reveal moderate but acceptable fit indices ($\chi^2 = 87.214; p = .000, D.F. = 35; NFI = 88; NNFI = .88; CFI = .92; GFI = .94; AGFI = .90; RMSEA = .076$). The observational variable psychological needs were well-explained by teachers' and students' thinking styles ($R^2 = .43$ for autonomy; $R^2 = .36$ for competency; and $R^2 = .37$ for relatedness). Structural configuration and standardized coefficients for the model (M2-E) are shown in Fig. 3. According to the data, M2-E is supported.

Table 2
Descriptive statistics and internal consistency of the scales (n = 266).

Scales	Items	M	DT	Cronbach α
<i>Teacher's styles (min = 1, max = 5)</i>				
T_Executive (F1)	5	2.64	0.94	.89
T_Liberal (F2)	5	3.05	0.84	.84
T_Judicial (F3)	5	2.73	0.76	.94
T_Legislative (F4)	5	2.98	0.67	.77
T_Conservative (F5)	5	2.90	0.73	.80
<i>Students' styles (min = 1, max = 6)</i>				
S_Liberal (F1)	5	5.20	0.79	.93
S_Conservative (F2)	4	3.07	0.85	.87
S_Judicial (F3)	5	4.75	0.73	.85
S_Legislative (F4)	5	4.93	0.71	.77
S_Executive (F5)	4	2.80	0.89	.82
<i>Psychological needs (min = 1, max = 5)</i>				
Need autonomy (F1)	6	2.92	0.80	.88
Need relatedness (F2)	6	3.58	0.72	.86
Need competency (F3)	6	3.69	0.67	.84
<i>Intrinsic motivation (min = 1, max = 4)</i>				
IM Knowledge (F1)	5	3.67	0.47	.89
IM Achievement (F2)	4	3.45	0.62	.87
IM Stimulant experiences (F3)	3	3.14	0.63	.73

Table 3
Pearson's bivariate correlations between the considered constructs (n = 266).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. T_Legislative	1															
2. T_Executive	-.499**	1														
3. T_Judicial	.448**	-.300**	1													
4. T_Liberal	.456**	-.267**	.393**	1												
5. T_Conservative	-.421**	.570**	-.293**	-.433**	1											
6. S_Legislative	.082	-.010	.054	.071	-.062	1										
7. S_Executive	.071	.076	.002	-.045	.109	-.343**	1									
8. S_Judicial	.109	-.006	.116	.112	-.105	.539**	-.248**	1								
9. S_Liberal	.093	.064	.066	.158*	-.087	.513**	-.205**	.669**	1							
10. S_Conservative	.005	.091	.107	.033	.182**	-.299**	.535**	-.244**	-.323**	1						
11. Need autonomy	.567**	-.418**	.450**	.469**	-.350**	-.065	.156*	.013	-.033	.114	1					
12. Need competence	.325**	-.120	.322**	.278**	-.229**	.138*	.039	.206**	.144*	.011	.353**	1				
13. Need relatedness	.125*	-.099	.093	.224**	-.148*	.039	-.055	.062	.055	.050	.194**	.236**	1			
14. IM Knowledge	.198**	-.059	.161**	.231**	-.179**	.150*	.019	.232**	.260**	-.012	.161**	.395**	.205**	1		
15. IM Achievement	.172**	-.030	.135*	.160**	-.095	.033	.012	.004	.107	.102	.143*	.221**	.151*	.323**	1	
16. IM St. experiences	.136*	.014	.088	.106	-.057	.054	-.021	.124*	.124*	.060	.077	.222**	.105	.464**	.343**	1

* $p < 0.05$.
** $p < 0.01$.

4. Discussion

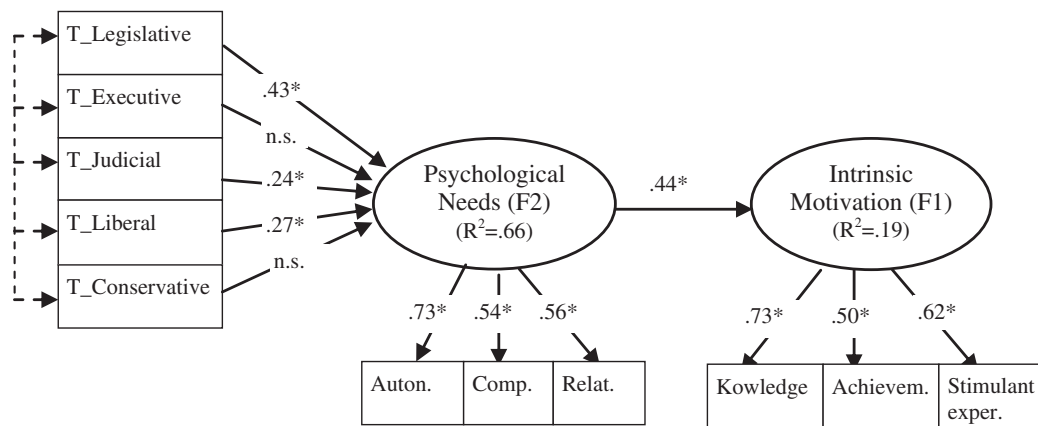
The results obtained from the two hypothesized causal models by considering first teachers' thinking styles as predictors-exogenous variables (M1) and second the interaction between teachers' and students' thinking styles as predictors-exogenous variables (M2), are discussed below.

In relation to the first causal model hypothesized (M1), the obtained results reveal the relationships expected among variables. Thus, the teachers' thinking styles classified as Type I (legislative, judicial and liberal) have a positive and significant effect on students' psychological needs ($R^2 = .66$) represented by a latent variable, measured by autonomy, self-competence and relatedness. In turn, students' psychological needs have a positive and significant effect on students' intrinsic motivation ($R^2 = .19$), represented by a latent variable, measured by three components: IM Knowledge, IM Achievement and IM Stimulant experiences. The results seem to indicate that the psychology students who perceived their teachers to conduct the teaching/learning process according to the Type I thinking styles (legislative, judicial and liberal) in the past were those who reported to have more fulfilled psychological needs (autonomy, self-competency and relatedness). Consequently, this increased their intrinsic motivation and they became more involved in these subject matters when they studied their Psychology Degree.

Regarding the second causal model hypothesized (M2), the fit indices reveal a better adjustment to the empirical data than the

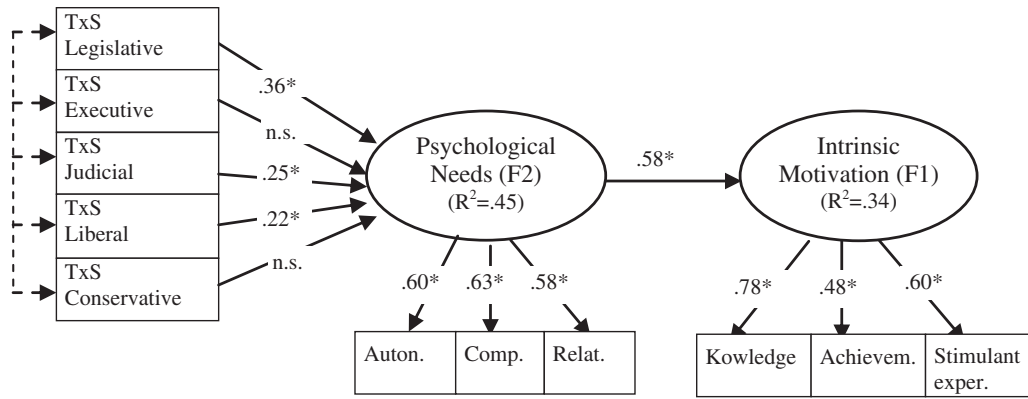
previous model. This means that when considering interactions between teachers' and the corresponding students' thinking styles as independent-exogenous variables, the model fit improves as compared with the previous model (M1), in which only teachers' thinking styles were considered to be independent-exogenous variables. However the results of more in-depth analyses reveal that the teachers' thinking styles from M1 are better predictors of student needs ($R^2 = .66$) than the interactions between teachers' and the corresponding students' thinking styles ($R^2 = .45$) from M2. Furthermore, none of the standardized coefficients from the Type II styles is significant for both models (see Figs. 1 and 2). According to these findings, the importance of adjustment between teachers' and students' thinking styles, as claimed by Sternberg (1997), is not proven at this stage since the interactions did not increase student needs satisfaction.

Models M1 and M2 were extended (M1-E and M2-E) by introducing the Type I and Type II thinking styles as two latent variables. According to the classification proposed by Zhang (2002b, 2004c), Type I was defined by the legislative, executive and liberal styles, whereas Type II was defined by the executive and conservative styles. The obtained values showed a poor fit for M1-E, and a moderate but satisfactory fit for M2-E, indicating that the latter model better fitted the empirical data. Moreover, the results of the more in-depth analysis of M2-E reveal that the Type I latent variable (whose indicators consisted in the interaction between teachers' and the corresponding students' thinking styles) has a significant effect on the three needs. Conversely, the Type II



Notes: * = significant ($p < .05$), n.s. = not significant

Fig. 1. Relationship among teachers' thinking styles, psychological needs and intrinsic motivation. The structural configuration and standardized coefficients of the M1 model are displayed.



Notes: * = significant ($p < .05$), n.s. = not significant

Fig. 2. Relationship among teachers' × students' thinking styles, psychological needs and intrinsic motivation. The structural configuration and standardized coefficients of the M2 model are displayed.

latent variable (whose indicators consisted in the interaction between teachers' and the corresponding students' thinking styles) has no significant effect on student needs (see Fig. 3). At this stage, the findings suggest that, first, Type I and Type II latent variables are better defined by the interactions between teachers' and the corresponding students' thinking styles than by only teachers' thinking styles; second, the interactions between teachers' and the corresponding students' thinking styles increase the adjustment of the model as compared to only teachers' thinking styles; third, the Type I teacher and homologous students' thinking styles interactions appear to be good predictors of the three student needs (autonomy, competence and relatedness), which means that, in line with Sternberg (1997), the Type I students' thinking styles may play a moderator role between the Type I teachers' thinking styles (learning environment) and student needs; finally, competence and relatedness appear to be good predictors of student intrinsic motivation.

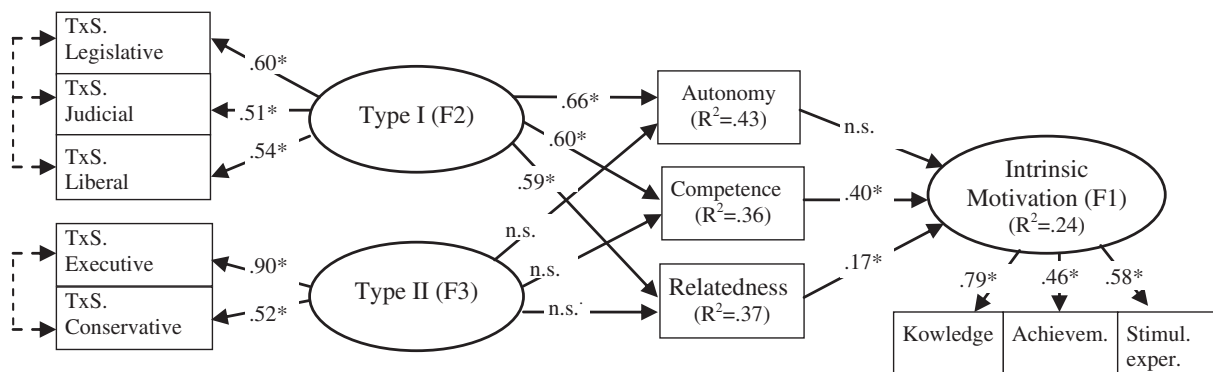
Contrary to what was expected, need of autonomy has no effect on intrinsic motivation. This may be because, traditionally in Spanish Universities, autonomous learning has not been enhanced by teachers until the recent creation of the European Higher Education Area; therefore, Spanish undergraduate students, who are not familiar with this methodology, still resist this new way of teaching and learning in European universities. This finding is consistent with previous studies conducted in the Spanish University context (Doménech & Gómez, 2011; García-Ros, Pérez-González, & Talaya, 2008).

4.1. Conclusions

Hypothesized connections were tested simultaneously in two separate structural models where teachers' and students' thinking style interaction was also examined. Overall, the results revealed that the Type I thinking styles have a significant and positive impact on student needs (autonomy, competence and relatedness). In turn, student needs (competence and relatedness) have a significant and positive impact on intrinsic motivation. Furthermore, it appears that the Type I students' thinking style may moderate the impact of the homologous Type I teachers' style on student needs. Thus, in order to fulfill student needs and to increase intrinsic motivation, it is also important that students adapt to the teaching environment designed by a teacher when applying the Type I thinking styles.

4.2. Limitations and suggestions for future research

Although the results obtained in this study are satisfactory, some limitations and suggestions for future research should be mentioned. The first major limitation is related to the generalizing of these findings. The present research was carried out by focusing on a specific context (Psychology Degree) and the sample size used was relatively small (above all, male participants). Further replication studies in another educative context with large samples are needed, and the effect of gender should be tested. We must, therefore, be cautious about



Notes: * = significant ($p < .05$), n.s. = not significant

Fig. 3. Relationship among teachers' x students' thinking styles, psychological needs and intrinsic motivation. The structural configuration and standardized coefficients of the M2-E model are displayed.

generalizing these findings. Second, and strictly speaking, the applied cross-sectional design does not provide any proof of causality. A temporal sequence between variables is required to establish a cause-effect relationship. Longitudinal studies are therefore required. When using cross-sectional survey studies, the data analysis with SEM appears to be the first step to at least obtain an idea of causality, as in this research work.

It would be beneficial for future research to test the models by including additional thinking styles and other types of motivation, as proposed by the SDT (extrinsic and amotivation). It might also be interesting for future research to take into account current teaching-learning models, such as the 3P Model (Biggs, 1978) and the DEDEPRO model (De la Fuente & Justicia, 2007), since these models would enable the thinking styles of teacher and students to be related with the teaching-learning behavior throughout the process, specifically with regulatory teaching and self-regulated learning.

4.3. Contributions and implications

Despite these reservations, the present study has contributed to a better understanding of the circumstances in which student intrinsic motivation can be activated, and about which role teachers should play in the university classroom in terms of thinking styles. These findings also have practical implications for improving students' psychological need satisfaction and, consequently, their intrinsic motivation. In line with previous studies (Doménech, 2007), applying the Type I thinking styles (legislative, judicial and liberal) to teaching is more beneficial for psychology students in terms of motivation than applying the Type II thinking styles (executive and conservative). Thus, psychology student needs are better fulfilled by those teachers who conduct the teaching-learning process according to the Type I thinking styles. If a class is conducted based on the Type I thinking styles, it enables students to work with autonomy (need of autonomy), has greater trust in their own capacities (need of self-competency) and interacts in an atmosphere of confidence (need of relatedness). As a result, students show more interest in the subject matters and get more involved in their learning process (intrinsic motivation). Accordingly, in higher education it is important for teachers to be aware and to reflect on their own instructional practice in order to redirect their teaching methodology to the Type I thinking styles.

References

- Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modelling in practice: a review and recommended two-step approach. *Psychological Bulletin*, *103*, 411–423. <http://dx.doi.org/10.1037/0033-2909.103.3.411>.
- Areepattamannil, S., & Freeman, J. G. (2008). Academic achievement, academic self-concept, and academic motivation of immigrant adolescents in the Greater Toronto Area secondary schools. *Journal of Advanced Academics*, *19*, 700–743.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497–529. <http://dx.doi.org/10.1037/0033-2909.117.3.497>.
- Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246.
- Bentler, P.M. (2006). *EQS structural equations program manual*. Encino, CA: Multivariate Software, Inc.
- Bentler, P.M., & Wu, E. J. C. (2002). *EQS for Windows user's guide*. Encino, CA: Multivariate Software, Inc.
- Biggs, J. B. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology*, *48*(3), 266–279.
- Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: a self-determination theory perspective. *Science Education*, *84*, 740–756.
- Brislin, R. W. (1986). The wording and translation of research instruments. In W. Lonner, & J. Berry (Eds.), *Field methods in cross-cultural research* (pp. 137–164). Beverly Hills, CA: Sage.
- Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing structural equation models* (pp. 132–162). Beverly Hills, CA: Sage.
- Cano-García, F., & Hughes, E. (2000). Learning and thinking styles: an analysis of their interrelationship and influence on academic achievement. *Educational Psychology*, *20*(4), 413–429. <http://dx.doi.org/10.1080/013663755>.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.) Mahwah, NJ: Erlbaum.
- Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, *1*, 16–29. <http://dx.doi.org/10.1037/1082-989X.1.1.16>.
- De la Fuente, J., & Justicia, F. (2007). The DEDEPRO model for regulating teaching and learning: recent advances. *Electronic Journal of Research in Educational Psychology*, *5*(3), 535–564.
- Deci, E. L., Connell, J. P., & Ryan, R. M. (1989). Self-determination in a work organization. *Journal of Applied Psychology*, *74*, 580–590. <http://dx.doi.org/10.1037/0021-9010.74.4.580>.
- Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, *53*, 1024–1037. <http://dx.doi.org/10.1037/0022-3514.53.6.1024>.
- Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: integration in personality. In R. Dienstbier (Ed.), *Nebraska symposium on motivation: perspectives on motivation*, Vol. 38. (pp. 237–288) Lincoln, USA: University of Nebraska Press.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuit: human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227–268. http://dx.doi.org/10.1207/S15327965PLI1104_01.
- Doménech, F. (2007). The influence of students' and teachers' thinking styles on student course satisfaction and on their learning process. *Educational Psychology*, *27*(2), 219–234. <http://dx.doi.org/10.1080/01443410601066701>.
- Doménech, F., & Gómez, A. (2011). The relationship among student psychological, need satisfaction, approaches to learning, reporting of avoidance strategies and achievement. *Electronic Journal of Research in Educational Psychology*, *9*(2), 463–496.
- Dunlap, W. P., & Kemery, E. (1987). Failure to detect moderating effects: is multicollinearity the problem? *Psychological Bulletin*, *102*, 418–420.
- Filak, V. F., & Sheldon, K. M. (2003). Student psychological need satisfaction and college teacher-course evaluation. *Educational Psychology*, *23*(3), 235–247. <http://dx.doi.org/10.1080/0144341032000060084>.
- García-Ros, R., Pérez-González, F., & Talaya, I. (2008). New university students' instructional preferences and how these relate to learning styles and motivational strategies. *Electronic Journal of Research in Educational Psychology*, *6*(3), 547–570.
- Gottfried, A. E. (1985). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology*, *77*, 631–645. <http://dx.doi.org/10.1037/0022-0663.77.6.631>.
- Gottfried, A. E., Marcoulides, G. A., Gottfried, A. W., Oliver, P., & Guerin, D. (2007). Multivariate latent change modeling of developmental decline in academic intrinsic math motivation and achievement: childhood through adolescence. *International Journal of Behavioral Development*, *31*, 317–327.
- Grigorenko, E. L., & Sternberg, R. J. (1997). Thinking styles. In D. Saklofske, & M. Zeidner (Eds.), *International handbook of personality and intelligence* (pp. 205–230). New York: Plenum.
- Hoyle, R. H. (1995). The structural equation modeling approach: basic concepts and fundamental issues. In R. H. Hoyle (Ed.), *Structural equation modeling, concepts, issues, and applications* (pp. 1–15). Thousand Oaks, CA: Sage.
- Hu, L., Bentler, P.M., & Kano, Y. (1992). Can test statistics in covariance structure analysis be trusted? *Psychological Bulletin*, *112*, 351–362.
- Ilardi, B. C., Leone, D., Kasser, R., & Ryan, R. M. (1993). Employee and supervisor rating of motivation: main effects and discrepancies associated with job satisfaction and adjustment in a factory setting. *Journal of Applied Social Psychology*, *23*, 1789–1805.
- Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.) New York: Guilford.
- Murphy, P. K., & Alexander, P. A. (2000). A motivated exploration of motivation terminology. *Contemporary Educational Psychology*, *25*, 3–53. <http://dx.doi.org/10.1006/ceps.1999.1019>.
- Núñez-Alonso, J. L., Martín-Albo, J., & Navarro, J. G. (2005). Validación de la versión española de la Échelle de Motivation en Éducation [Validated version of the Academic Motivation Scale]. *Psicothema*, *17*(2), 344–349.
- Pintrich, P. R. (2000). An achievement goal theory perspective on issues in motivation terminology, theory and research. *Contemporary Educational Psychology*, *25*, 92–104. <http://dx.doi.org/10.1006/ceps.1999.1017>.
- Reeve, J., Deci, E. L., & Ryan, R. M. (2004). Self-determination theory: a dialectical framework for understanding sociocultural influences on student motivation. In D.M. McInerney, & S. Van Etten (Eds.), *Big theories revisited. Research on sociocultural influences on motivation and learning*, Vol. 4. (pp. 31–60). Greenwich, Connecticut: Information Age Publishing.
- Reeve, J., Ryan, R., Deci, E., & Jang, H. (2008). Understanding and promoting autonomous self-regulation: a self-determination perspective. In D. Schunk, & B. Zimmerman (Eds.), *Motivation and self-regulated learning: theory, research, and applications* (pp. 223–244). London: LEA.
- Reis, H., Sheldon, K., Gable, S., Roscoe, J., & Ryan, R. (2000). Daily well-being: the role of autonomy, competence and relatedness. *Personality and Social Psychology Bulletin*, *26*, 419–435. <http://dx.doi.org/10.1177/0146167200266002>.
- Ryan, M. R., Connell, J. P., & Grolnick, W. S. (1992). When achievement is not intrinsically motivated: a theory of internalization and self-regulation in school. In A. K. Boggiano, & T. S. Pittman (Eds.), *Achievement and motivation. A social-developmental perspective* (pp. 167–188). New York: Cambridge University Press.
- Ryan, M. R., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78. <http://dx.doi.org/10.1037/0003-066X.55.1.68>.

- Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: an organismic dialectical perspective. In E. L. Deci, & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester: The University of Rochester Press.
- Ryan, R., & Stiller, J. (1991). The social contexts of internalization: parents and teacher influences on autonomy, motivation and learning. In P. R. Pibtrich, & M. L. Maehr (Eds.), *Advances in motivation and achievement. Goals and self-regulating process*, 7. (pp. 115–149). Greenwich, CT: JAI Press.
- Satorra, A., & Bentler, P.M. (1988). Scaling corrections for chi-square statistics in covariance structure analysis. *Proceedings of the Business and Economic Statistics Section of the American Statistical Association*, 1988, 308–313.
- Satorra, A., & Bentler, P.M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. von Eye, & C. C. Clogg (Eds.), *Latent variables analysis: applications to developmental research* (pp. 399–419). Newbury Park CA: Sage.
- Sheldon, K., & Biddle, B. (1998). Standards, accountability and school reform: perils and pitfalls. *Teacher College Record*, 100, 164–180.
- Sheldon, K. M., Elliot, A. J., Kim, Y., & Kasser, T. (2001). What's satisfying about satisfying events? Comparing ten candidate psychological needs. *Journal of Personality and Social Psychology*, 80, 325–339.
- Sheldon, K., Ryan, R., & Reis, H. (1996). What makes for a good day? Competence and autonomy in the day and in the person. *Personality and Social Psychology Bulletin*, 22, 66–84. <http://dx.doi.org/10.1177/01461672962212007>.
- Sternberg, R. J. (1993). Intellectual styles: theory and classroom implications. In B. Z. Presseesen (Ed.), *Learning and thinking styles: classroom interaction* (pp. 8–42). Washington, DC: National Education Association of the United States Research for Better Schools.
- Sternberg, R. J. (1994). Allowing for styles of thinking. *Educational Leadership*, 52(3), 36–41.
- Sternberg, R. J. (1997). *Thinking styles*. Cambridge, England: Cambridge University Press.
- Sternberg, R. J., & Grigorenko, E. L. (1995). Styles of thinking in the school. *European Journal for High Ability*, 6, 201–219.
- Vallerand, R. J., Blais, M. R., Brière, N. M., & Pelletier, L. G. (1989). Construction et validation de l'Échelle de Motivation en Éducation (EME). *Canadian Journal of Behavioral Sciences*, 21, 323–349.
- Vallerand, R. J., Pelletier, L. G., Blais, M. R., Brière, N. M., Senécal, C., & Vallières, E. F. (1992). The Academic Motivation Scale: a measure of intrinsic, extrinsic and amotivation in education. *Educational and Psychological Measurement*, 52, 1.003–1.017.
- Zhang, L. F. (2002a). Thinking styles and big five personality traits. *Educational Psychology*, 22, 17–31. <http://dx.doi.org/10.1080/01443410120101224>.
- Zhang, L. F. (2002b). Thinking styles: their relationships with modes of thinking and academic performance. *Educational Psychology*, 22, 331–347. <http://dx.doi.org/10.1080/01443410220138557>.
- Zhang, L. F. (2004a). Do university students' thinking styles matter in their preferred teaching approaches? *Personality and Individual Differences*, 37(8), 1551–1564. <http://dx.doi.org/10.1016/j.paid.2004.02.012>.
- Zhang, L. F. (2004b). Revisiting the predictive power of thinking styles for academic performance. *Journal of Psychology*, 138(4), 351–370. <http://dx.doi.org/10.3200/JRLP.138.4.351-370>.
- Zhang, L. F. (2004c). Thinking styles: university students' preferred teaching styles and their conceptions of effective teachers. *Journal of Psychology*, 13(3), 233–252. <http://dx.doi.org/10.3200/JRLP.138.3.233-252>.
- Zhang, L. F. (2008). Teachers' styles of thinking: an exploratory study. *Journal of Psychology*, 142(1), 37–55. <http://dx.doi.org/10.3200/JRLP.142.1.37-56>.
- Zhang, L. F., & Sternberg, R. J. (1998). Thinking styles, abilities and academic achievement among Hong Kong university students. *Educational Research Journal*, 13, 41–62.
- Zhang, L. F., & Sternberg, R. J. (2000). Are learning approaches and thinking styles related? A study in two Chinese populations. *Journal of Psychology*, 134, 469–489. <http://dx.doi.org/10.1080/00223980009598230>.
- Zhang, L. F., & Sternberg, R. J. (2001). Thinking styles across cultures: their relationship with student learning. In R. J. Sternberg, & L. F. Zhang (Eds.), *Perspectives on thinking, learning and cognitive styles* (pp. 197–226). Mahwah, NJ: Lawrence Erlbaum.