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Running Head: Students' Psychological Need States

Rethinking Students' Psychological Need States: The Unique Role of Need Unfulfillment to Understanding Ill-Being in Academic Settings

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Data available upon request from the authors.

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Abstract

Prior research has shown that students face various stressors which can affect their psychological health. The present study examines the role of students' psychological need states in explaining their burnout and dropout intentions. More precisely, relying on recent findings from Self-Determination Theory research, we examined whether students' psychological need unfulfillment could contribute to explain their ill-being over and above need satisfaction and frustration. To this end, we also tested the validity of a tripartite instrument allowing to assess these need states in academic settings (Psychological Need States in Education-Scale, PNSE-S). A study was conducted among two samples of high school ($N = 473$; Sample 1) and college ($N = 1143$; Sample 2) students. Results supported the construct validity of the 35-item PNSE-S in both samples by showing that students' relatedness, autonomy, and competence unfulfillment can be modeled as distinct need states alongside the frustration and satisfaction of those three needs. Moreover, these different need states displayed a well-differentiated pattern of associations with various facets of student burnout and with dropout intentions. Results also showed the critical role of psychological need unfulfillment in explaining students' ill-being.

Keywords: Need unfulfillment, need frustration, need satisfaction, Psychological Need States in Education-Scale, burnout, dropout.

Introduction

Student burnout and dropout have become a major concern for students and their families, but also for high schools, universities, and governments (e.g., World Economic Forum, 2022). Indeed, these key indices of students' ill-health or ill-being (e.g., Hardré & Reeve, 2003; Lee et al., 2010), resulting from various stressors experienced by students, have critical implications in terms of psychological functioning, academic performance, and reduced professional opportunities (e.g., Gillet et al., 2020; Lee et al., 2010). Student burnout refers to a syndrome characterized by feelings of exhaustion or weariness (cognitive, physical, and emotional exhaustion), by a cynical or detached attitude toward different targets (e.g., detachment toward studies, teachers, and other students), and by feelings of inadequacy (Berjot et al., 2022; also see Salmela-Aro et al., 2022). Dropout intentions refer to students' thoughts regarding the possibility of leaving their school or university program before they complete it or graduate; such intentions are recognized to be a key predictor of actual dropout behaviors (Gillet et al., 2020).

Given their detrimental consequences, researchers have looked into the antecedents of student burnout and dropout intentions to identify possible levers for intervention. Interestingly, research based on Self-Determination Theory (SDT, Ryan & Deci, 2017) has shown the satisfaction and frustration of students' needs for relatedness (feeling connected to others), competence (feeling able and adequate) and autonomy (feeling responsible for one's actions) to be important drivers of student burnout and dropout intentions (e.g., Gillet et al., 2020; Zhang & Jiang, 2023). Need satisfaction reflects a positive state where students' psychological needs are fulfilled (i.e., feeling affiliated, competent and volitional), while need frustration refers to the negative state where students' psychological needs feel undermined (i.e., feeling rejected, useless, and coerced).

Importantly, recent research suggests that considering the "dim light colors" of psychological needs, alongside their bright (need satisfaction) and dark (need frustration) sides, could extend our understanding of students' ill-being (see Ntoumanis, 2022). Indeed, building upon theoretical suggestions (Bhavsar et al., 2020; Cheon et al., 2019; Costa et al., 2015), recent research in the work domain indicates that psychological need experiences are not Manichean or black-and-white in nature (need satisfaction and frustration), but that individuals can also experience a foggier and insidious need experience labeled need unfulfillment (i.e., feeling that one's psychological needs are in a state of neglect or abandonment; Huyghebaert-Zouaghi et al., 2021, 2023). More precisely, individuals may experience uncertainty, ambiguity and a lack of purpose or meaning (autonomy unfulfillment), a sense of not fitting in or not having much in common with their peers (relatedness unfulfillment), and a feeling of not performing or improving as well/much as they could (competence unfulfillment). Huyghebaert-Zouaghi et al. (2021) demonstrated the existence of this psychological need experience (and its distinctiveness from need frustration and satisfaction), in samples of French- and English-speaking workers. Interestingly, Huyghebaert-Zouaghi et al. (2021) also showed need unfulfillment to independently explain indices of ill- and well-being (i.e., work-related rumination, job boredom, job satisfaction) over and above what was explained by need satisfaction and frustration. As such, examining the dim light colors of students' psychological needs (i.e., need unfulfillment) could enrich our understanding of the psychological experiences that might lead to students' burnout and dropout and, thus, allow for better prevention strategies.

Indeed, just like employees, students may experience need unfulfillment (e.g., feelings of uncertainty and disconnection) which could contribute to explaining passive forms of ill-being characterized by withdrawal (e.g., boredom, disengagement, dropout intentions; Ntoumanis, 2022). Unfortunately, research attempting to demonstrate the distinctiveness of these need states among students has been incomplete. Cheon et al. (2019) supported the distinctiveness of autonomy unfulfillment (relative to autonomy frustration and satisfaction) in a sample of Korean middle- and high-school students, yet this study only considered the need for autonomy, thus failing to test the distinctiveness of competence and relatedness unfulfillment. However, all three psychological needs have been demonstrated to be important "psychological nutrients" that are critical for psychological functioning (Vansteenkiste et al., 2020), so that one or more need(s) cannot be set aside if one wishes to get a complete understanding of experiential need states and their implications for individuals' health.

As such, the main aim of this paper was to examine the unfulfillment, frustration, and satisfaction of students' psychological needs (see Huyghebaert-Zouaghi et al., 2021) in relation to students' burnout (i.e., emotional, physical, and cognitive exhaustion; psychological disengagement from other students,

teachers and studies; feelings of inadequacy) and dropout intentions, as these are known to be critical indicators of student ill-health (Berjot et al., 2022; Hardré & Reeve, 2003). Providing support for the incremental value of need unfulfillment (relative to need frustration and satisfaction) in explaining these important outcomes in samples of high school and college students would contribute to assert its distinctiveness, provide further evidence that need unfulfillment is a key mechanism in understanding ill-being in education, and would replicate past work in sport and work settings. To this end, we also aimed to examine the validity of the Psychological Need States in Education-Scale (PNSE-S), an adapted version of the Psychological Need States at Work-Scale (PNSW-S, validated in English and French by Huyghebaert-Zouaghi et al., 2021), to allow researchers and practitioners to simultaneously measure the bright, dark, and dim light colors of students' psychological need states and access their possibly distinct consequences.

Hypotheses

In line with prior research findings, we expect students' need satisfaction states to have negative associations with their burnout (e.g., Salmela-Aro et al., 2022; Zhang & Jiang, 2023) and dropout intentions (e.g., Gillet et al., 2020). We thus hypothesize that when students feel competent, autonomous, and related to others, they are more energized and reassured about their own capabilities, hence are less likely to feel exhausted, cynical or inadequate (burnout) and less likely to think about quitting (dropout intentions) (Hypothesis 1). With regard to need frustration, research has, to the best of our knowledge, not yet examined the links between this need state and students' dropout intentions, while very few studies have looked into the relations between need frustration and student burnout. These rare studies found that students characterized by higher levels of general need frustration experience higher levels of burnout (Kusurkar et al., 2021; Zhang & Jiang, 2023). Indeed, when experiencing coercion, isolation and worthlessness, students may tap into their resources in an effort to cope with this negative experience, eventually draining these resources and their energy (i.e., burnout). Moreover, when their integrity is threatened (i.e., need frustration), individuals tend to initiate self-protective and defensive processes (Vansteenkiste et al., 2020), which may take the form of intentions to withdraw from the education setting altogether. We can thus expect need frustration states to relate to increased burnout and to fuel dropout intentions (Hypothesis 2).

Because no study has yet examined autonomy, competence, and relatedness unfulfillment in education contexts, we lack evidence regarding their links with student burnout and dropout. However, Cheon et al. (2019) found classroom disengagement to be more strongly predicted by autonomy unfulfillment than by autonomy frustration. Similarly, in the work context, job boredom was predicted by need unfulfillment but not by need frustration, while work-related rumination was predicted by need frustration but not by unfulfillment states (Huyghebaert-Zouaghi et al., 2021). Interestingly, these results are in line with theoretical suggestions arguing that these need states contribute to explain ill-being indices of a different nature (Cheon et al., 2019; Huyghebaert-Zouaghi et al., 2021, 2023): While intense maladaptive outcomes (e.g., ruminative thoughts, contingent self-worth, psychological distress) are proposed to stem primarily from need frustration, maladaptive outcomes characterized by passivity and deactivation (e.g., amotivation, boredom, disengagement) are thought to mainly result from need unfulfillment. Indeed, when individuals perceive their psychological needs to be undermined (need frustration) they may engage in self-criticism (e.g., feelings of inadequacy) and defensiveness to cope with this adverse experience, which may come with resource depletion (e.g., exhaustion). Contrastingly, feeling that these needs are in a state of abandonment (i.e., need unfulfillment) may trigger consequences characterized by passivity, withdrawal and deactivation, as individuals give in to this seemingly insoluble ambiguous experience of nothingness. As such, we expect need frustration states to best predict consequences characterized by self-criticism and depletion (i.e., feelings of inadequacy and the exhaustion dimensions of burnout) and need unfulfillment states to most strongly predict outcomes characterized by passivity and withdrawal (i.e., dropout intentions, detachment facets of burnout) (Hypothesis 3).

Method

Participants and Procedure

We did not apply for university ethics approval, based on French national regulations regarding this type of research. Nonetheless, this study was conducted in compliance with the American Psychological Association ethical standards and with the Helsinki Declaration and its amendments. A convenience sample was recruited, and participants did not receive compensation for their participation.

They were sent an email summarizing the objectives of the research, reminding them of the voluntary and anonymous nature of their participation, and providing them with a link to the online survey. They were then invited to provide written informed consent to take part in the study. In total, 473 high school students (Sample 1; $M_{age} = 16.47$; $SD_{age} = .86$; 82.9% female) and 1143 college students (Sample 2; $M_{age} = 20.47$; $SD_{age} = 4.11$; 78.2% women), living in France, completed the survey.

Measures

To estimate reliability of each of the a priori factors, we relied on model-based coefficients of composite reliability (Omega coefficient: ω ; McDonald, 1970), a measure of reliability known to overcome the limitations of more traditional reliability estimates such as Cronbach's Alpha (see Hayes & Coutts, 2020).

Psychological need states were assessed with the French version of PNSE-S. We adapted some of the items developed by Huyghebaert-Zouaghi et al. (2021) by changing words such as "professional tasks" to "activities"; we also changed the stem "In my job ..." to "In my studies ...". Students were invited to indicate their level of agreement with each of the 37 statements (13 items for need frustration, 12 for need satisfaction, and 12 for need unfulfillment) while thinking of their general experience in their studies (autonomy satisfaction: $\omega_{S1} = .856$, $\omega_{S2} = .862$, competence satisfaction: $\omega_{S1} = .907$, $\omega_{S2} = .913$, relatedness satisfaction: $\omega_{S1} = .926$, $\omega_{S2} = .929$, autonomy frustration: $\omega_{S1} = .749$, $\omega_{S2} = .734$, competence frustration: $\omega_{S1} = .956$, $\omega_{S2} = .956$, relatedness frustration: $\omega_{S1} = .937$, $\omega_{S2} = .923$, autonomy unfulfillment: $\omega_{S1} = .836$, $\omega_{S2} = .870$, competence unfulfillment: $\omega_{S1} = .773$, $\omega_{S2} = .830$, relatedness unfulfillment: $\omega_{S1} = .883$, $\omega_{S2} = .895$) on a seven-point response scale.

Student burnout was measured with the Burnout Integrative Measure (BIM; Berjot et al., 2022) validated in French to measure student burnout. Students indicated their degree of agreement with each of the 27 statements (cognitive exhaustion: $\omega_{S1} = .926$, $\omega_{S2} = .936$, physical exhaustion: $\omega_{S1} = .885$, $\omega_{S2} = .863$, emotional exhaustion: $\omega_{S1} = .852$, $\omega_{S2} = .837$, detachment toward other students: $\omega_{S1} = .761$, $\omega_{S2} = .815$, teachers: $\omega_{S1} = .843$, $\omega_{S2} = .841$, studies: $\omega_{S1} = .840$, $\omega_{S2} = .892$, inadequacy: $\omega_{S1} = .895$, $\omega_{S2} = .908$) on a six-point response scale.

Dropout intentions were measured through three items ($\omega_{S1} = .741$, $\omega_{S2} = .846$) adapted from Hardré & Reeve (2003). Students indicated their level of agreement on a six-point response scale.

Results

Construct validity

The psychometric properties of the PNSE-S were tested via preliminary factor analyses using Mplus 8.6 (Muthén & Muthén, 2021) and the maximum likelihood robust (MLR) estimator. More precisely, relying on prior procedures (e.g., Bhavsar et al., 2020; Huyghebaert-Zouaghi et al., 2021, 2023), multiple confirmatory factor analyses (CFA), exploratory structural equation modeling (ESEM), bifactor CFA (B-CFA) and bifactor ESEM (B-ESEM) models were tested and compared within each sample. Due to space restrictions, these analyses (factor structure and composite reliability) are detailed in the Online Supplements. The construct validity of a 35-item version of the PNSE-S was supported (see Appendix). More precisely, in both samples, even though the nine-factor CFA solution (and its bifactor counterpart) displayed adequate levels of fit to the data and well-defined factors, the ESEM solution with nine factors and the B-ESEM solution with nine specific (S-) factors and one global (G) factor both displayed superior levels of fit to the data (compared to the CFA solutions) and well-defined factors. We decided to rely on the nine-factor ESEM solution to continue our analyses in both samples, as this solution seemed more conceptually consistent with SDT and in line with previous studies of psychological need states (see Bhavsar et al., 2020; Huyghebaert-Zouaghi et al., 2021; also see the Online Supplements for more details).

Criterion-related validity

A predictive model was tested for each sample, including psychological need states represented as a nine-factor ESEM solution and outcomes represented as CFA solutions (see Figure 1 for an overview of the overall model and the Online Supplements for more details on the measurement model for the outcomes). This predictive model reached an adequate level of fit to the data both in Sample 1: $\chi^2(df) = 3,279.376$ (1671), CFI = .928, TLI = .910, SRMR = .045, RMSEA = .045 (.043; .047) and Sample 2: $\chi^2(df) = 5,338.779$ (1671), CFI = .932, TLI = .915, SRMR = .045, RMSEA = .044 (.043; .045). Results revealed the different need states to have well-differentiated relations with a wide array of outcomes (see Table 1), thus supporting the criterion-related validity of the PNSE-S. We further discuss these associations in the following section.

Discussion

The present work aimed to provide a first examination of students' need unfulfillment states (alongside their need frustration and satisfaction) and of their implications for students' ill-being (i.e., burnout and dropout intentions).

Theoretical and Practical Implications

This research supported the distinctiveness of students' need unfulfillment states when modeled alongside their need frustration and need satisfaction states. These distinct psychological need states were found to have well-differentiated patterns of relations with outcomes among high school and college students, thus, enriching our understanding of the psychological experiences leading to students' burnout and dropout intentions.

More specifically, as expected, need satisfaction states were negatively related to burnout dimensions and to dropout intentions in both samples, thus confirming that when their psychological needs are fulfilled, students are less at risk of experiencing maladjustment (Ryan & Deci, 2017). Only one exception was found among college students, for whom competence satisfaction positively predicted detachment from teachers (although this relation was much weaker than those held by other predictors). It is possible that the more college students feel efficient and confident, the more they become critical of and cynical about their teachers. More research is clearly needed to examine the psychological processes at play.

Need frustration states were, as expected, positively related to burnout dimensions and to dropout intentions in both samples. More precisely, in line with our expectations, feelings of inadequacy were most strongly predicted by competence frustration in both samples, thus confirming that when students' psychological needs are undermined, they are more inclined to experience actively negative consequences characterized by rumination and self-criticism (Cheon et al., 2019; Huyghebaert-Zouaghi et al., 2021, 2023). Unexpectedly, the exhaustion facets were not best predicted by need frustration but rather equally, if not more strongly, by need unfulfillment states. This was even more true among college students for whom unfulfillment states (particularly those related to autonomy and competence) were the strongest predictors of all three exhaustion facets, thus showing the detrimental effect of need unfulfillment and its importance in the prediction of depletion. Interestingly, Huyghebaert-Zouaghi et al. (2021, 2023) suggested that perceiving one's psychological needs to be in a state of abandonment may trigger deactivation, which characterizes exhaustion.

Need unfulfillment states were also, as hypothesized, positively related to the indices of ill-being in both samples, thus confirming this psychological need state to be deleterious. Only one exception was found among high school students for whom competence unfulfillment negatively predicted dropout intentions. This could be explained by the possibility that, when they feel like they are not performing as well as they could, students lack the confidence and drive to quit their current situation and pursue new challenges. More importantly, in line with our expectations, the detachment facets of burnout and dropout intentions were most strongly predicted (as indicated by high to very high associations) by need unfulfillment states in both samples. Such findings offer support to the argument that ill-being forms characterized by passivity, withdrawal, and deactivation stem from students perceiving their psychological needs to be in a state of abandonment (Huyghebaert-Zouaghi et al., 2021, 2023). Students may give in to this ambiguous experience of nothingness (need unfulfillment) with resignation and disengagement.

This research also contributes to SDT by showing the 3x3 psychological need states conceptual model (see Huyghebaert-Zouaghi et al., 2021) to generalize to both high school and college students. As such, we extend knowledge on the essence of students' psychological need states as we show that students' need states are not Manichean or black-and-white (need frustration and satisfaction) in nature. Rather, students can also experience a negative psychological experience of a hazy and deactivated nature, reflected by feelings of disconnection, dullness, and uncertainty (need unfulfillment). In this paper, we also provided validity evidence for a 35-item multidimensional instrument (i.e., the PNSE-S) of psychological need states, based on SDT (Ryan & Deci, 2017). Importantly, despite the superiority of nine-factor (bifactor-) ESEM solutions to represent ratings on the PNSE-S, the nine-factor (bifactor) CFA solutions were also satisfactory. These alternative models suggest that researchers and practitioners interested in less complex statistical representations of these need states could confidently rely on more traditional methods (e.g., nine-factor CFA). More generally, our research opens new horizons for SDT researchers to further shed light on these experiential states in different school settings (e.g., primary

schools) by relying on the extended conceptualization and measure of psychological need states provided in this study.

Study Limitations

Even though this research deepens our understanding of students' psychological need states and ill-being, it still has some limitations. First, we relied on self-reported cross-sectional data. Future research using longitudinal designs (e.g., Huyghebaert-Zouaghi et al., 2023) or objective dropout data could strengthen our observations. Second, our findings supported the validity of the PNSE-S in one language only; the scale therefore needs further validation in other languages such as English (see item translations in the Appendix). This would allow future studies to test the generalizability of this 3x3 psychological need states model in different cultures, which would contribute to support the universality claim of basic psychological needs theory (Vansteenkiste et al., 2020). Notwithstanding these limitations, this research contributes to the stress and health literature by supporting the necessity of comprehending not just the dark (need frustration) and the bright (need satisfaction) sides, but also the dim light colors (need unfulfillment) of psychological need states to explain individuals' psychological health. Future research would gain in exploring the predictors of these psychological need states among students to identify levers for intervention. For instance, studies could examine how students' psychological need states are predicted by teachers' or peers' interpersonal styles (i.e., need-supportive, -thwarting, -indifferent; Bhavsar et al., 2019; Huyghebaert-Zouaghi et al., 2023). Moreover, in the present research, we focused on the dark side of students' psychological health and future studies could extend knowledge on the relations between these different psychological need states and well-being indices (alongside ill-being; e.g., Huyghebaert-Zouaghi et al., 2021), to get a more complete understanding of their implications for students' health.

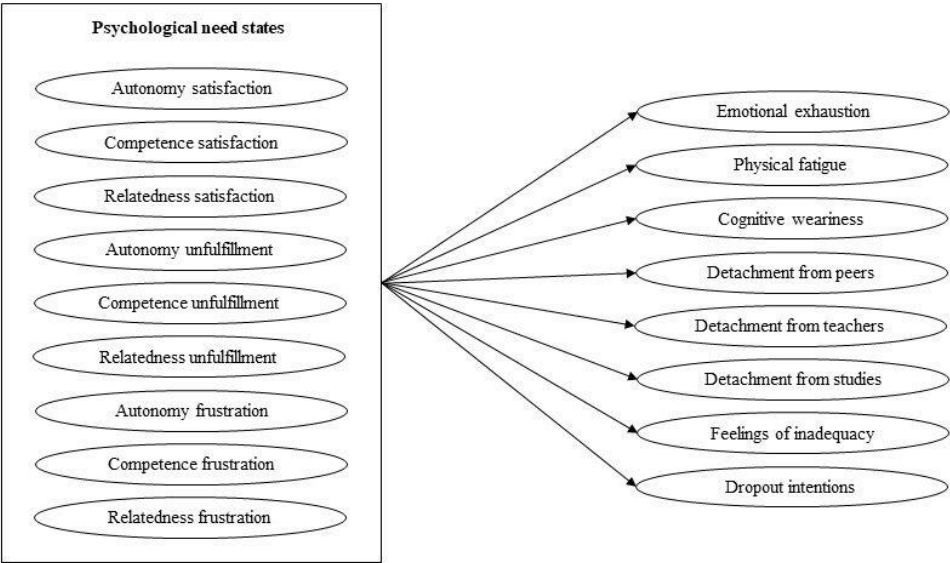
References

- Berjot, S., Weber, T., & Huyghebaert-Zouaghi, T. (2022). Burnout Integrative Measure: A preliminary validation among French college students. *Frontiers in Psychology, 13*, Article 904367. <https://doi.org/10.3389/fpsyg.2022.904367>
- Bhavsar, N., Ntoumanis, N., Quedsted, E., Gucciardi, D. F., Thøgersen-Ntoumani, C., Ryan, R. M., ... & Bartholomew, K. J. (2019). Conceptualizing and testing a new tripartite measure of coach interpersonal behaviors. *Psychology of Sport and Exercise, 44*, 107-120. <https://doi.org/10.1016/j.psychsport.2019.05.006>
- Bhavsar, N., Bartholomew, K. J., Quedsted, E., Gucciardi, D. F., Thøgersen-Ntoumani, C., Reeve, J., Sarrazin, P., & Ntoumanis, N. (2020). Measuring psychological need states in sport: Theoretical considerations and a new measure. *Psychology of Sport & Exercise, 47*, Article 101617. <https://doi.org/10.1016/j.psychsport.2019.101617>
- Cheon, S. H., Reeve, J., Lee, Y., Ntoumanis, N., Gillet, N., Kim, B. R., & Song, Y.-G. (2019). Expanding autonomy psychological need states from two (satisfaction, frustration) to three (dissatisfaction): A classroom-based intervention study. *Journal of Educational Psychology, 111*, 685–702. <https://doi.org/10.1037/edu0000306>
- Costa, S., Ntoumanis, N., & Bartholomew, K. (2015). Predicting the brighter and darker sides of interpersonal relationships: Does psychological need thwarting matter? *Motivation and Emotion, 39*, 11–24. <https://doi.org/10.1007/s11031-014-9427-0>
- Hardré, P. L., & Reeve, J. (2003). A motivational model of rural students' intentions to persist in, versus drop out of, high school. *Journal of Educational Psychology, 95*, 347–356. <https://doi.org/10.1037/0022-0663.95.2.347>
- Gillet, N., Morin, A. J., Huyghebaert-Zouaghi, T., Alibrán, E., Barrault, S., & Vanhove-Meriaux, C. (2020). Students' need satisfaction profiles: Similarity and change over the course of a university semester. *Applied Psychology, 69*, 1396–1437. <https://doi.org/10.1111/apps.12227>
- Hayes, A. F., & Coutts, J. J. (2020). Use omega rather than Cronbach's alpha for estimating reliability. But... *Communication Methods and Measures, 14*, 1–24. <https://doi.org/10.1080/19312458.2020.1718629>
- Huyghebaert-Zouaghi, T., Gillet, N., Fernet, C., Thomas, J., & Ntoumanis, N. (2023). Managerial predictors and motivational outcomes of workers' psychological need states profiles: A two-wave examination. *European Journal of Work and Organizational Psychology, 32*, 216–233. <https://doi.org/10.1080/1359432X.2022.2127354>

- Huyghebaert-Zouaghi, T., Ntoumanis, N., Berjot, S., & Gillet, N. (2021). Advancing the conceptualization and measurement of psychological need states: A 3×3 model based on self-determination theory. *Journal of Career Assessment*, 29, 396–421. <https://doi.org/10.1177/1069072720978792>
- Kusurkar, R. A., van der Burgt, S. M., Isik, U., Mak-van der Vossen, M., Wilschut, J., Wouters, A., & Koster, A. S. (2021). Burnout and engagement among PhD students in medicine: The BEeP study. *Perspectives on Medical Education*, 10, 110-117. doi.org/10.1007/s40037-020-00637-6
- Lee, J., Puig, A., Kim, Y. B., Shin, H., Lee, J. H., & Lee, S. M. (2010). Academic burnout profiles in Korean adolescents. *Stress and Health*, 26, 404–416. <https://doi.org/10.1111/jpr.12251>
- McDonald, R. (1970). Theoretical foundations of principal factor analysis, canonical factor analysis, and alpha factor analysis. *British Journal of Mathematical & Statistical Psychology*, 23, 1–21. <https://doi.org/10.1111/j.2044-8317.1970.tb00432.x>
- Muthén, L.K., & Muthén, B. (2021). *Mplus user's guide*. Muthén & Muthén.
- Ntoumanis, N. (2022). The bright, dark, and dim light colors of motivation: Advances in conceptualization and measurement from a self-determination theory perspective. In A. J. Elliot (Ed.), *Advances in Motivation Science* Vol. 9. Elsevier. <https://doi.org/10.1016/bs.adms.2022.11.002>
- Ryan, R. M. & Deci, E. L. (2017). *Self-determination theory. Basic psychological needs in motivation, development and wellness*. Guilford Press. <https://doi.org/10.1521/978.14625/28806>
- Salmela-Aro, K., Upadyaya, K., Ronkainen, I., & Hietajärvi, L. (2022). Study burnout and engagement during COVID-19 among university students: The role of demands, resources, and psychological needs. *Journal of Happiness Studies*, 23, 2685–2702. <https://doi.org/10.1007/s10902-022-00518-1>
- Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation and Emotion*, 44, 1–31. <https://doi.org/10.1007/s11031-019-09818-1>
- World Economic Forum. (2022). More students are dropping out of college in the US – here's why. <https://www.weforum.org/agenda/2022/09/college-student-dropouts-2022/>
- Zhang, L., & Jiang, Y. (2023). Patterns of the Satisfaction and Frustration of Psychological Needs and Their Associations with Adolescent Students' School Affect, Burnout, and Achievement. *Journal of Intelligence*, 11, 111. <https://doi.org/10.3390/jintelligence11060111>

Figure 1

Overall Predictive Model Tested in Sample 1 and Sample 2



Note. Psychological need states were represented as a nine-factor ESEM solution and outcomes were represented according to a CFA model with eight distinct but correlated factors. In each sample, a total of 72 links were specified between the nine psychological need states and the eight outcome factors.

Table 1

Results from the Predictive Model

Sample 1 Predictors	Feelings of inadequacy		Emotional exhaustion		Physical fatigue		Cognitive weariness		Detachment from peers		Detachment from teachers		Detachment from studies		Dropout intentions	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
Autonomy satisfaction	.101	.096	.039	.089	.078	.095	.027	.079	.015	.082	-.005	.084	.070	.080	-.034	.084
Competence satisfaction	-.598	.160**	-.224	.121	-.031	.115	-.249	.105*	-.141	.118	-.089	.111	-.280	.114*	-.172	.103
Relatedness satisfaction	-.090	.112	-.197	.097*	-.217	.089*	-.156	.087	-.160	.086	-.324	.090**	-.096	.089	.094	.080
Autonomy unfulfillment	.365	.125**	.231	.141	.072	.186	.200	.112	-.130	.107	.674	.106**	.499	.107**	.406	.097**
Competence unfulfillment	.371	.119**	.267	.103**	.358	.118**	.496	.108**	.083	.097	.041	.089	-.031	.091	-.083	.089
Relatedness unfulfillment	.295	.119*	.218	.104*	.165	.107	.064	.099	.798	.124**	.140	.097	.204	.104*	.143	.095
Autonomy frustration	.392	.233	.508	.272	.454	.377	.384	.181*	.089	.137	.106	.126	.233	.149	.134	.140
Competence frustration	.792	.149**	.336	.125**	.322	.116**	.132	.104	-.105	.116	.031	.112	.154	.115	.148	.106
Relatedness frustration	.001	.123	-.073	.107	.020	.100	-.069	.101	.333	.108**	.032	.110	.006	.111	.025	.103
Sample 2 Predictors	Feelings of inadequacy		Emotional exhaustion		Physical fatigue		Cognitive weariness		Detachment from peers		Detachment from teachers		Detachment from studies		Dropout intentions	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
Autonomy satisfaction	.084	.053	-.007	.053	-.031	.049	-.004	.046	-.116	.054	-.084	.052	.024	.048	.006	.046
Competence satisfaction	-.493	.077**	-.107	.064	-.082	.059	-.123	.055*	-.149	.064*	.218	.063**	-.241	.060**	-.183	.058**
Relatedness satisfaction	-.180	.052**	-.321	.052**	-.252	.049**	-.156	.047**	-.009	.054	-.419	.048**	-.174	.046**	-.046	.042
Autonomy unfulfillment	.398	.061**	.373	.059**	.224	.054**	.205	.050**	.086	.059	.527	.060**	.450	.059**	.344	.054**
Competence unfulfillment	.429	.070**	.333	.068**	.312	.070**	.470	.066**	.033	.068	.039	.062	.008	.061	-.114	.056*
Relatedness unfulfillment	.018	.054	.024	.053	-.028	.053	-.067	.048	.931	.080**	-.047	.051	.190	.052**	.208	.053**
Autonomy frustration	.032	.066	.126	.069	.117	.072	.019	.060	-.055	.068	.089	.065	.100	.063	.030	.060
Competence frustration	.889	.093**	.330	.071**	.201	.066**	.100	.058	.047	.075	.042	.067	.251	.068**	.193	.066**
Relatedness frustration	.054	.065	.066	.065	.065	.058	.130	.056*	.271	.077**	.094	.063	-.007	.063	-.072	.063

Note. * $p < .05$; ** $p < .01$; *b*: unstandardized regression coefficient; *SE*: standard error of the coefficient.

Appendix*Final 35-item Version of the PNSW-S in English and in French*

Stem: In my studies, ... [Dans mes études, ...]

Autonomy Satisfaction [Satisfaction du besoin d'autonomie]

...I feel free to make choices with regards to the way I work [...je me sens libre de faire des choix quant à ma manière de travailler] (aS1)

...I have a say in how things are done [...j'ai mon mot à dire quant à la manière de faire les choses] (aS2)

...I have the freedom to make decisions about my work [...j'ai la liberté de prendre des décisions quant à mon travail] (aS3)

Competence Satisfaction [Satisfaction du besoin de compétence]

...I feel that I am capable [...je me sens compétent·e] (cS1)

...I feel skilled [...je me sens qualifié·e] (cS2)

...I am able to overcome challenges [...je me sens capable de surmonter des challenges] (cS3)

Relatedness Satisfaction [Satisfaction du besoin d'affiliation sociale]

...I feel supported [...je me sens soutenu·e] (rS1)

...I feel listened to [...je me sens écouté·e] (rS2)

...I feel valued [...je me sens estimé·e] (rS3)

...I feel cared for [...j'ai le sentiment d'avoir de l'importance aux yeux des autres] (rS4)

Autonomy Frustration [Frustration du besoin d'autonomie]

...I feel pushed to behave in certain ways [...j'ai le sentiment d'être poussé·e à me comporter d'une certaine manière] (aF1)

...I feel forced to follow decisions [...je me sens forcé·e de suivre des décisions] (aF2)

...I feel a lot of unwanted pressure [...je ressens une énorme pression dont je me passerais volontiers] (aF3)

...I feel forced to do tasks that I would not choose to do [...je me sens obligé·e de participer à des tâches que je n'aurais pas choisies] (aF4)

Competence Frustration [Frustration du besoin de compétence]

...I feel like a failure [...j'ai le sentiment d'être un·e raté·e] (cF1)

...I feel useless [...je me sens inutile] (cF2)

...I feel incapable [...je me sens incompetent·e] (cF3)

...I feel hopeless [...je me sens nul·le] (cF4)

Relatedness Frustration [Frustration du besoin d'affiliation sociale]

- ...I feel rejected [...je me sens rejeté·e] (rF1)
- ...I feel brushed aside [...j'ai le sentiment d'être mis·e à l'écart] (rF2)
- ...I feel disliked [...je me sens détesté·e] (rF3)
- ...I feel excluded [...je me sens exclu·e] (rF4)
- ...I feel isolated [...je me sens isolé·e] (rF5)

Autonomy Unfulfillment [Inassouvissement du besoin d'autonomie]

- ...I am unsure as to why we do certain activities [...je ne sais pas trop pourquoi on fait certaines activités] (aU2)
- ...I am confused as to when I can make decisions [...je ne sais jamais vraiment quand je peux, ou non, prendre des décisions] (aU5)
- ...I often do not understand the rationale behind the activities that I am assigned [...souvent, je ne comprends pas la justification des activités que je dois réaliser] (aU6)
- ...I often do not understand the rationale for how my work is expected to be done [...souvent je ne comprends pas pourquoi mon travail doit être réalisé de cette façon] (aU7)

Competence Unfulfillment [Inassouvissement du besoin de compétence]

- ...I feel like I have achieved less than I would have liked to [...j'ai le sentiment de réaliser moins de choses que ce que je voudrais] (cU2)
- ...I feel like I have improved less than I would have liked to [...j'ai le sentiment de m'être moins amélioré·e que je ne l'aurais voulu] (cU3)
- ...generally, I am not satisfied with my performance [...je ne suis généralement pas satisfait·e de ma performance] (cU6)

Relatedness Unfulfillment [Inassouvissement du besoin d'affiliation sociale]

- ...I have little in common with others [...j'ai peu de choses en commun avec les autres] (rU1)
- ...I have little shared interest with others [...je partage peu d'intérêts avec les autres] (rU2)
- ...I feel I don't quite fit in with the others [...je ne me sens pas à ma place avec les autres] (rU3)
- ...I have no close friends [...je n'ai pas d'ami·e·s proches] (rU4)
- ...I feel like others know little about me [...j'ai le sentiment que les autres me connaissent peu] (rU5)

Note. The English translations are adapted from the validated English version of the PNSW-S. This English version of the PNSE-S has not yet been validated in education settings.

Online Supplemental Materials for:

Rethinking Students' Psychological Need States: The Unique Role of Need Unfulfillment to Understanding Ill-Being in Academic Settings

Preliminary Measurement Models

Due to the complexity of the models underlying all constructs assessed in the present study, preliminary analyses were conducted separately for the psychological need states and outcomes (student burnout and dropout intentions). These measurement models were estimated using Mplus 8.6 (Muthén & Muthén, 2021) using the maximum likelihood robust (MLR) estimator, which provides parameter estimates, standard errors, and goodness-of-fit that are robust to the non-normality of the response scales used in the present study. Given the known oversensitivity of the chi-square test of exact fit (χ^2) to sample size and minor model misspecifications (e.g., Marsh et al., 2005), we relied on sample-size independent goodness-of-fit indices to describe model fit (Hu & Bentler, 1999): The comparative fit index (CFI), the Tucker-Lewis index (TLI), as well as the root mean square error of approximation (RMSEA) and its 90% confidence interval. Values greater than .90 for the CFI and TLI indicate adequate model fit, although values greater than .95 are preferable. Values smaller than .08 or .06 for the RMSEA respectively support acceptable and excellent model fit.

Psychological Need States

The goodness-of-fit results from all psychological need states models are reported in Table S1. In line with past studies (e.g., Bhavsar et al., 2020; Huyghebaert-Zouaghi et al., 2021, 2023), a series of confirmatory factor analyses (CFA) and exploratory structural equation modeling (ESEM) models were tested in each sample: (a) three-factor CFA (Model 1) and ESEM (Model 2) models (need satisfaction, frustration, and unfulfillment); (b) nine-factor CFA (Model 3) and ESEM (Model 4) models (autonomy satisfaction, relatedness satisfaction, competence satisfaction, autonomy frustration, relatedness frustration, competence frustration, autonomy unfulfillment, relatedness unfulfillment, and competence unfulfillment); (c) bifactor CFA (Model 5) and ESEM (Model 6) models with three specific (S)-factors (need satisfaction, frustration, and unfulfillment) and one global (G)-factor (global psychological need experience); and (d) bifactor CFA (Model 7) and ESEM (Model 8) models including nine S-factors (autonomy satisfaction, relatedness satisfaction, competence satisfaction, autonomy frustration, relatedness frustration, competence frustration, autonomy unfulfillment, relatedness unfulfillment, and competence unfulfillment) and one G-factor (global psychological need experience).

In the CFA models, items were only allowed to define their a priori factors, factors were allowed to correlate, and no cross-loadings were estimated. In the ESEM models, the factors were defined as in the CFA models, and all cross-loadings were freely estimated but assigned a target value of zero using an oblique target rotation procedure (Browne, 2001). In bifactor CFA models, items were allowed to define one a priori S-factor as well as one G-factor, and all factors were specified as orthogonal. Bifactor ESEM models were specified as their bifactor CFA counterparts, although all cross-loadings involving the S-factors were freely estimated but assigned a target value of zero using an orthogonal bifactor target rotation procedure (Reise, 2012).

As noted by Morin et al. (2016, 2017), fit indices are not sufficient to guide the selection of the optimal model. An examination of the parameter estimates is also required to select the best alternative. When contrasting a CFA or an ESEM solution with a bifactor alternative, the key elements supporting a bifactor representation are: (1) an improved level of fit to the data; (2) a well-defined (i.e., presenting moderate to strong significant target loadings) as opposed to a weakly defined (i.e., weak target loadings) G-factor; and (3) at least some reasonably well-defined S-factors. It should be noted that there is no formal guideline regarding the exact values beyond which one can interpret factors to be well-defined and S-factors to retain enough specificity. Instead, target loadings and model-based coefficients of composite reliability (omega coefficient; ω) are typically interpreted in a more holistic manner.

In both samples, only two solutions were able to achieve an acceptable level of fit to the data (Models 4 and 8). The ESEM solution with nine factors (Model 4) resulted in a majority of well-defined factors and a minority of more weakly-defined factors. The bifactor ESEM solution with one G-factor and nine S-factors (Model 8) revealed a well-defined G-factor with negative factor loadings associated with the need satisfaction items, and positive factor loadings associated with the need frustration and unfulfillment items. The S-factors retained at least some degree of meaningful specificity over and above employees' global levels of psychological need experience. However, although these solutions seemed acceptable and superior to alternative solutions in both samples, results indicated that the psychometric properties of the Psychological Need States in Education-Scale (PNSE-S) still had room for improvement. Indeed, in both samples, both solutions (Models 4 and 8) showed that two items (rS5 and rS6) had low factor loadings on their a priori factor (relatedness satisfaction) and problematic cross-loadings on other specific factors. Interestingly, one of these items (i.e., rS5) was already found to be

problematic in prior studies in the work context (e.g., Huyghebaert-Zouaghi et al., 2021, 2023). Therefore, in line with the procedure recently followed by Huyghebaert-Zouaghi et al. (2023), this item was excluded from further analyses. Each solution was tested again without rS5 but results indicated that rS6 remained problematic (i.e., low factor loadings and problematic cross-loadings), suggesting that this item might be specifically inadequate to measure relatedness satisfaction in education settings. In line with prior procedures (e.g., Huyghebaert-Zouaghi et al., 2021, 2023), this item was thus also removed, and all solutions were tested again (i.e., without rS5 and rS6).

In both samples, four solutions were able to achieve an acceptable level of fit to the data and displayed well-defined factors: nine-factor CFA (Model 9) and ESEM (Model 10) models (autonomy satisfaction, relatedness satisfaction, competence satisfaction, autonomy frustration, relatedness frustration, competence frustration, autonomy unfulfillment, relatedness unfulfillment, and competence unfulfillment); as well as bifactor CFA (Model 11) and ESEM (Model 12) models including nine S-factors (autonomy satisfaction, relatedness satisfaction, competence satisfaction, autonomy frustration, relatedness frustration, competence frustration, autonomy unfulfillment, relatedness unfulfillment, and competence unfulfillment) and one G-factor (global psychological need experience). In both samples, the (bifactor)-ESEM solutions (i.e., models 10 and 12) proved to be superior and were thus retained, over their CFA counterparts, for closer examination. Both solutions displayed very similar levels of fit to the data and well-defined factors where all items significantly loaded on their a priori factor (with all positive significant cross-loadings being substantially smaller than the target loadings). Because both these representations of psychological need states proved to be valid, a decision had to be made to retain one or the other for further analyses to explore associations with criterion variables. In line with Huyghebaert-Zouaghi et al. (2021) methodological and conceptual arguments, we chose to pursue our analyses with the nine-factor ESEM solution (Model 10), which appears to be more conceptually consistent with SDT (Bhavsar et al., 2020; Huyghebaert-Zouaghi et al., 2021). This model's parameter estimates are reported in Tables S2 (Sample 1) and S3 (Sample 2). Composite reliability coefficients associated with each of the a priori factors are calculated from the model standardized parameters using McDonald (1970) omega (ω) coefficient:

$$\omega = \frac{(\sum |\lambda_i|)^2}{[(\sum |\lambda_i|)^2 + \sum \delta_i]}$$

where $|\lambda_i|$ are the standardized factor loadings associated with a factor in absolute values, and δ_i , the item uniquenesses.

More precisely, in each sample, results from this final solution (Model 10) revealed well-defined autonomy satisfaction ($\lambda_{\text{Sample 1}} = .677$ to $.867$, $\lambda_{\text{Sample 2}} = .787$ to $.883$, $\omega_{\text{Sample 1}} = .856$, $\omega_{\text{Sample 2}} = .862$), competence satisfaction ($\lambda_{\text{Sample 1}} = .602$ to $.887$, $\lambda_{\text{Sample 2}} = .667$ to $.956$, $\omega_{\text{Sample 1}} = .907$, $\omega_{\text{Sample 2}} = .913$), relatedness satisfaction ($\lambda_{\text{Sample 1}} = .586$ to $.956$, $\lambda_{\text{Sample 2}} = .633$ to $.966$, $\omega_{\text{Sample 1}} = .926$, $\omega_{\text{Sample 2}} = .929$), autonomy unfulfillment ($\lambda_{\text{Sample 1}} = .465$ to $.831$, $\lambda_{\text{Sample 2}} = .456$ to $.990$, $\omega_{\text{Sample 1}} = .836$, $\omega_{\text{Sample 2}} = .870$), competence unfulfillment ($\lambda_{\text{Sample 1}} = .475$ to $.857$, $\lambda_{\text{Sample 2}} = .620$ to $.885$, $\omega_{\text{Sample 1}} = .773$, $\omega_{\text{Sample 2}} = .830$), relatedness unfulfillment ($\lambda_{\text{Sample 1}} = .467$ to $.948$, $\lambda_{\text{Sample 2}} = .530$ to $.991$, $\omega_{\text{Sample 1}} = .883$, $\omega_{\text{Sample 2}} = .895$), autonomy frustration ($\lambda_{\text{Sample 1}} = .401$ to $.907$, $\lambda_{\text{Sample 2}} = .332$ to $.835$, $\omega_{\text{Sample 1}} = .749$, $\omega_{\text{Sample 2}} = .734$), competence frustration ($\lambda_{\text{Sample 1}} = .821$ to $.875$, $\lambda_{\text{Sample 2}} = .838$ to $.904$, $\omega_{\text{Sample 1}} = .956$, $\omega_{\text{Sample 2}} = .956$), and relatedness frustration ($\lambda_{\text{Sample 1}} = .668$ to $.929$, $\lambda_{\text{Sample 2}} = .567$ to $.945$, $\omega_{\text{Sample 1}} = .937$, $\omega_{\text{Sample 2}} = .923$) factors.

Student Outcomes

In line with prior research on student burnout and dropout (e.g., Berjot et al., 2022; Gillet et al., 2020) and with the procedures recently followed by Huyghebaert-Zouaghi et al. (2021) to test the criterion-related validity of this psychological need states scale in work settings, in each sample, the outcomes were represented according to a CFA model with eight distinct but correlated factors (i.e., cognitive, physical and emotional weariness; detachment toward other students, teachers and studies; feelings of inadequacy; and dropout intentions). These models (Sample 1: M13; Sample 2: M14) achieved a satisfactory fit to the data according to all goodness-of-fit indices (see Table S1) and displayed well-defined factors in both samples.

References

- Berjot, S., Weber, T., & Huyghebaert-Zouaghi, T. (2022). Burnout Integrative Measure: A preliminary validation among French college students. *Frontiers in Psychology, 13*, 904367.
- Bhavsar, N., Bartholomew, K. J., Queded, E., Gucciardi, D. F., Thøgersen-Ntoumani, C., Reeve, J., Sarrazin, P., & Ntoumanis, N. (2020). Measuring psychological need states in sport: Theoretical considerations and a new measure. *Psychology of Sport & Exercise, 47*, Article 101617.
- Browne, M.W. (2001). An overview of analytic rotation in exploratory factor analysis. *Multivariate Behavioral Research, 36*, 111–150.
- Gillet, N., Morin, A. J., Huyghebaert-Zouagh, T., Alibrán, E., Barrault, S., & Vanhove-Meriaux, C. (2020). Students' need satisfaction profiles: Similarity and change over the course of a university semester. *Applied Psychology, 69*, 1396–1437.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55.
- Huyghebaert-Zouaghi, T., Gillet, N., Fernet, C., Thomas, J., & Ntoumanis, N. (2023). Managerial predictors and motivational outcomes of workers' psychological need states profiles: A two-wave examination. *European Journal of Work and Organizational Psychology, 32*, 216–233.
- Huyghebaert-Zouaghi, T., Ntoumanis, N., Berjot, S., & Gillet, N. (2021). Advancing the conceptualization and measurement of psychological need states: A 3×3 model based on self-determination theory. *Journal of Career Assessment, 29*, 396–421.
- Marsh, H.W., Hau, K.-T., & Grayson, D. (2005). Goodness of fit evaluation in structural equation modeling. In A. Maydeu-Olivares & J. McArdle (Eds.), *Contemporary psychometrics. A Festschrift for Roderick P. McDonald*. Erlbaum.
- Muthén, L.K., & Muthén, B. (2021). *Mplus user's guide*. Muthén & Muthén.
- McDonald, R. (1970). Theoretical foundations of principal factor analysis, canonical factor analysis, and alpha factor analysis. *British Journal of Mathematical & Statistical Psychology, 23*, 1-21.
- Morin, A.J.S., Arens, A.K., & Marsh, H.W. (2016). A bifactor exploratory structural equation modeling framework for the identification of distinct sources of construct-relevant psychometric multidimensionality. *Structural Equation Modeling, 23*, 116–139.
- Morin, A.J.S., Boudrias, J.-S., Marsh, H.W., McInerney, D.M., Dagenais-Desmarais, V., Madore, I., & Litalien, D. (2017). Complementary variable- and person-centered approaches to exploring the dimensionality of psychometric constructs: Application to psychological wellbeing at work. *Journal of Business & Psychology, 32*, 395–419.
- Reise, S.P. (2012). The rediscovery of bifactor measurement models. *Multivariate Behavioral Research, 47*, 667–696.

Table S1*Goodness-of-Fit Statistics for the Measurement Models*

Description	χ^2 (df)	CFI	TLI	RMSEA	90% CI
<i>Psychological Need States – Sample 1</i>					
M1. Three-factor CFA	5477.680 (626)*	.586	.560	.128	[.125; .131]
M2. Three-factor ESEM	3724.436 (558)*	.730	.678	.110	[.106; .113]
M3. Nine-factor CFA	1686.008 (593)*	.907	.895	.062	[.059; .066]
M4. Nine-factor ESEM	696.432 (369)*	.972	.950	.043	[.038; .048]
M5. B-CFA: Three S-factors and one G-factor	3580.401 (592)*	.745	.713	.103	[.100; .107]
M6. B-ESEM: Three S-factors and one G-factor	2609.598 (524)*	.822	.774	.092	[.088; .095]
M7. B-CFA: Nine S-factors and one G-factor	1808.845 (592)*	.896	.883	.066	[.063; .069]
M8. B-ESEM: Nine S-factors and one G-factor	537.397 (341)*	.983	.967	.035	[.029; .040]
M9. Model 3 (Nine-factor CFA) without rS5 and rS6	1149.855 (524)*	.943	.935	.050	[.046; .054]
M10. Model 4 (Nine-factor ESEM) without rS5 and rS6	516.462 (316)*	.982	.966	.037	[.031; .042]
M11. Model 7 (B-CFA: Nine S-factors and one G-factor) without rS5 and rS6	1386.366 (525)*	.922	.911	.059	[.055; .063]
M12. Model 8 (B-ESEM: Nine S-factors and one G-factor) without rS5 and rS6	450.611 (290)*	.985	.970	.034	[.028; .040]
<i>Psychological Need States – Sample 2</i>					
M1. Three-factor CFA	13106.093 (626)*	.558	.529	.128	[.130; .134]
M2. Three-factor ESEM	10577.068 (558)*	.645	.576	.125	[.123; .127]
M3. Nine-factor CFA	3553.704 (593)*	.895	.882	.066	[.064; .068]
M4. Nine-factor ESEM	1197.180 (369)*	.971	.947	.044	[.042; .047]
M5. B-CFA: Three S-factors and one G-factor	9385.700 (592)*	.688	.649	.114	[.112; .116]
M6. B-ESEM: Three S-factors and one G-factor	7149.143 (524)*	.765	.701	.105	[.103; .107]
M7. B-CFA: Nine S-factors and one G-factor	3512.635 (592)*	.896	.884	.066	[.064; .068]
M8. B-ESEM: Nine S-factors and one G-factor	792.259 (341)*	.984	.969	.034	[.031; .037]
M9. Model 3 (Nine-factor CFA) without rS5 and rS6	2155.873 (524)*	.937	.929	.052	[.050; .054]
M10. Model 4 (Nine-factor ESEM) without rS5 and rS6	837.380 (316)*	.980	.962	.038	[.035; .041]
M11. Model 7 (B-CFA: Nine S-factors and one G-factor) without rS5 and rS6	2386.826 (525)*	.929	.919	.056	[.053; .058]
M12. Model 8 (B-ESEM: Nine S-factors and one G-factor) without rS5 and rS6	581.728 (290)*	.989	.977	.030	[.026; .033]
<i>Student Outcomes</i>					
M13. Sample 1: Eight-factor CFA	1074.575 (369)*	.921	.906	.064	[.059; .068]
M14. Sample 2: Eight-factor CFA	2204.373 (368)*	.918	.903	.066	[.063; .069]

Note. * $p < .05$; CFA: Confirmatory factor analysis; ESEM: Exploratory structural equation modeling; B: Bifactor; χ^2 : Scaled chi-square test of exact fit; *df*: Degrees of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; 90% CI: 90% confidence interval.

Table S2

Standardized Factor Loadings (λ) and Uniquenesses (δ) for Model 10 (Nine-Factor ESEM Representation of Psychological Need States) in Sample 1 (High School Students)

Items	rS λ	aS λ	cS λ	rF λ	aF λ	cF λ	rU λ	aU λ	cU λ	δ
rS										
rS1	.927	.043	-.020	.040	.001	.003	.005	-.055	.035	.144
rS2	.956	-.020	-.054	.011	-.050	.048	.036	-.017	-.046	.138
rS3	.843	.015	.079	.019	.056	-.084	.005	-.018	.009	.181
rS4	.586	.028	.132	-.080	-.008	-.028	-.137	.061	.036	.419
aS										
aS1	.016	.677	.044	-.028	-.027	-.034	.042	-.005	-.050	.455
aS2	.008	.867	-.003	.030	-.003	-.004	.007	.034	.048	.270
aS3	.018	.867	-.025	-.020	.018	.047	-.022	-.018	-.016	.256
cS										
cS1	-.002	.045	.887	.022	.002	-.041	-.038	-.016	-.014	.111
cS2	.044	-.031	.958	-.038	-.016	.106	.005	-.041	-.028	.120
cS3	.091	.047	.602	-.084	-.067	-.112	.105	.076	-.037	.386
rF										
rF1	-.003	-.014	-.026	.824	.006	.076	.012	.066	-.006	.176
rF2	.004	.002	.016	.816	.020	.024	.093	-.003	.080	.143
rF3	-.012	-.007	-.066	.754	-.048	.095	-.017	.081	-.072	.343
rF4	-.001	.007	-.043	.929	-.002	-.031	.016	.025	-.013	.124
rF5	-.026	-.032	.008	.668	.063	.062	.136	-.065	.051	.281
aF										
aF1	-.024	.056	.042	.114	.660	-.041	-.105	.008	.035	.572
aF2	.030	-.025	-.047	.007	.907	-.079	-.005	-.064	-.006	.274
aF3	-.056	-.005	-.016	-.139	.487	.163	.135	-.094	.131	.598
aF4	.034	-.068	-.051	-.079	.401	.117	.103	.323	-.202	.578
cF										
cF1	-.010	-.017	-.006	.040	.052	.871	-.014	-.019	.019	.145
cF2	-.052	-.027	.051	.075	.052	.821	.030	.036	-.009	.171
cF3	.017	-.012	-.117	.049	.030	.807	-.019	.022	.041	.109
cF4	-.061	.031	.003	.040	-.038	.875	.010	.007	.072	.105
rU										
rU1	.049	.016	-.001	-.082	.029	.071	.844	.105	-.017	.274
rU2	.014	-.018	-.003	-.077	-.013	-.012	.948	.045	-.028	.206
rU3	.039	-.073	-.024	.204	.017	-.058	.714	-.034	.101	.238

rU4	-.096	.030	.111	.213	-.009	-.016	.467	-.093	-.046	.633
rU5	-.140	.074	.002	.049	.053	-.033	.673	-.053	.057	.405
aU										
aU2	-.056	.051	-.045	.074	.011	.007	-.007	.689	.013	.450
aU5	-.003	-.017	.023	.113	.161	.141	.001	.465	.057	.486
aU6	.013	-.008	-.054	-.003	.027	-.025	.079	.831	.026	.204
aU7	-.088	-.071	.049	-.006	.011	-.011	-.006	.697	.203	.269
cU										
cU2	-.083	-.002	.074	.045	.117	-.084	-.020	.203	.574	.448
cU3	.028	-.033	-.036	.021	-.010	.019	-.005	.023	.857	.208
cU6	.030	.006	-.181	-.059	-.049	.241	.149	.063	.475	.408
ω	.926	.856	.907	.937	.749	.956	.883	.836	.773	

Note. Target factor loadings are indicated in bold. Non-significant parameters ($p \geq .05$) are marked in italics. rS = relatedness satisfaction; aS = autonomy satisfaction; cS = competence satisfaction; rF = relatedness frustration; aF = autonomy frustration; cF = competence frustration; rU = relatedness unfulfillment; aU = autonomy unfulfillment; cU = competence unfulfillment; λ = factor loading; δ = item uniqueness; ω = omega coefficient of model-based composite reliability.

Table S3

Standardized Factor Loadings (λ) and Uniquenesses (δ) for Model 10 (Nine-Factor ESEM Representation of Psychological Need States) in Sample 2 (College Students)

Items	rS λ	aS λ	cS λ	rF λ	aF λ	cF λ	rU λ	aU λ	cU λ	δ
rS										
rS1	.933	-.008	-.010	-.011	-.007	.041	-.005	-.031	.040	.154
rS2	.966	-.028	-.035	-.004	-.054	.016	.023	.003	.025	.128
rS3	.848	.029	.052	.015	-.028	-.027	.045	.003	-.046	.183
rS4	.633	.044	.075	-.043	.088	-.035	-.142	.008	-.011	.405
aS										
aS1	-.007	.787	-.006	-.005	-.013	-.018	-.010	-.021	.030	.370
aS2	.006	.789	.040	.021	-.011	.021	-.018	.017	-.020	.352
aS3	-.001	.883	-.009	-.007	.010	-.009	.028	.023	-.005	.244
cS										
cS1	-.017	.010	.922	-.021	-.002	-.012	.010	.012	-.033	.106
cS2	.001	-.008	.956	-.010	-.023	.053	-.006	.016	-.010	.131
cS3	.081	.044	.667	.026	-.004	-.087	-.009	-.087	.044	.383
rF										
rF1	-.027	-.006	.040	.795	.014	.137	.019	.018	-.007	.181
rF2	-.003	.004	-.030	.945	-.005	-.038	-.011	.000	.018	.135
rF3	.029	-.039	.033	.717	.041	.074	-.006	.083	-.078	.402
rF4	.019	.016	-.063	.945	-.010	-.063	.030	.015	-.012	.128
rF5	-.107	.002	.005	.567	.024	.031	.051	-.058	.145	.468
aF										
aF1	.092	.071	-.050	.049	.798	-.045	-.002	-.069	-.078	.511
aF2	-.038	-.074	.015	-.026	.835	-.029	.035	-.035	.008	.283
aF3	-.149	.008	-.040	-.004	.354	.196	-.084	-.006	.183	.576
aF4	-.038	-.055	.040	.017	.332	.030	.071	.312	-.012	.577
cF										
cF1	.002	-.013	.005	.015	.021	.866	.051	.006	-.001	.175
cF2	-.058	.006	.037	.045	.060	.847	.036	.017	-.031	.176
cF3	.027	-.003	-.100	.020	.008	.838	-.013	.019	.056	.106
cF4	.006	-.028	-.030	.042	-.025	.904	-.014	.001	.025	.090
rU										
rU1	-.006	.008	-.001	-.123	.055	.001	.897	.036	.048	.233
rU2	.007	.016	.026	-.104	.002	.030	.991	.016	-.019	.135
rU3	.042	-.015	-.052	.105	.009	.010	.808	.017	-.019	.212

rU4	-.078	-.020	.003	.159	-.033	-.041	.530	-.059	-.037	.618
rU5	-.041	-.006	.021	.121	-.033	-.002	.604	-.047	.068	.514
aU										
aU2	-.004	.038	.009	-.006	.031	.037	.053	.723	-.013	.430
aU5	.046	-.036	-.031	.121	.144	.048	.073	.456	.129	.418
aU6	-.016	-.003	-.061	-.001	-.067	-.013	-.004	.990	-.022	.088
aU7	-.062	-.039	.025	.027	.064	.003	-.052	.716	.089	.312
cU										
cU2	.018	.001	.004	.020	.078	-.071	.019	.111	.704	.404
cU3	-.018	-.047	.024	.048	-.015	-.059	-.014	.019	.885	.235
cU6	.007	.036	-.102	-.045	-.018	.204	.078	-.030	.620	.361
ω	.929	.862	.913	.923	.734	.956	.895	.870	.830	

Note. Target factor loadings are indicated in bold. Non-significant parameters ($p \geq .05$) are marked in italics. rS = relatedness satisfaction; aS = autonomy satisfaction; cS = competence satisfaction; rF = relatedness frustration; aF = autonomy frustration; cF = competence frustration; rU = relatedness unfulfillment; aU = autonomy unfulfillment; cU = competence unfulfillment; λ = factor loading; δ = item uniqueness; ω = omega coefficient of model-based composite reliability.