No Pain, No Gain? Satisfaction and Frustration of Basic Psychological Needs, Somatic Burden, Giving Up, and Life Satisfaction in Music Students

Abstract

Performance-related somatic symptoms may include pain, weakness, numbness, tingling, and they are commonly experienced by students in *higher music education*. From a Self-Determination Theory perspective, this study examines the relationship between the basic psychological needs satisfaction and frustration, somatic symptom burden, giving up, and life satisfaction among music performance students (n = 281). Two theoretical models were tested hypothesising that music students' basic psychological need satisfaction (BPNS) would be negatively associated with both students' somatic symptoms and giving up, and positively related to general life-satisfaction. Basic psychological need frustration (BPNF) was anticipated to have the opposite relations. The two models were confirmed. Participants whose basic psychological needs were satisfied were unlikely to be burdened by somatic symptoms and giving up, and simultaneously likely to experiencing high levels of general life-satisfaction. Conversely, participants whose basic psychological needs were frustrated were more likely to be burdened by various somatic symptoms and to giving up facing adversity. Need-frustrated participants also reported low levels of life satisfaction. This study contributed to extending the application of Self-Determination Theory to address somatic symptom burden in the context of music performance. Educational implications are discussed in the light of teaching and learning in higher music education.

Keywords: motivation; self-determination theory; somatic symptom burden; instrumental practice; musicians

The foremost activity observed around and within music conservatories is instrumental practice. Music students dedicate numerous hours to refining their skills in pursuit of excellence (Jørgensen & Lehmann, 1997). This journey towards mastery can be both rewarding and complex, characterized by productivity and achievements, as well as competition, underlying rivalry, and playing-related injuries. Evidently, these contrasting aspirational characteristics in music education places a particularly strong emphasis in motivation. According to Self-Determination Theory, the environment plays a particularly important role in determining both adaptive and maladaptive outcomes based on the extent to which basic psychological needs for autonomy, relatedness and competence are satisfied or frustrated (Deci & Ryan 2000; 2017). Despite an impressive body of SDT research both within and outside music, it is less clear weather basic psychological need satisfaction and frustration (BPNSF) affect music students' burden with somatic symptoms, and to which extent BPNSF is related to coping and general life-satisfaction. In order to start filling this empirical gap, the present study examined two theoretical models covering 1) basic psychological need satisfaction (BPNS) and 2) basic psychological need frustration (BPNF) as separate constructs, and their relations to somatic symptom burden, general life satisfaction and giving up.

Overview of theory, constructs and previous research

Somatic Symptom Burden in Music

A substantial body of research points to music practice and performance as a particularly straining endeavour for the human physiology (Kok et al., 2016; Rotter et al., 2020). Performance-related musculoskeletal pain (PRMD) is "pain, weakness, numbness, tingling, or other symptoms that interfere with musicians' ability to play their instrument at the level they are

accustomed to" (Zaza et al., 1998), and it can start to appear even among adolescent music talents. Between 25.8 and 84.4%, of music students' experience one or more form of PRMD (Silva et al., 2015), and one of the foremost risk factors of PRMD is practicing without breaks (Cruder et al., 2020). As such, eager music students seem to be extremely, and at times overly, motivated to do well and progress as rapidly as possible (Hatfield, 2016). Yet, at the same time, they lack knowledge and patience to prevent potentially adverse outcomes (Rickert et al., 2015). Accordingly, one study reported that as many as 94% of young elite-string players reported practicing and playing with pain, and shoulders, neck, and thoracic areas are the most burdened (Robitaille et al., 2015). The frequency of reported performance-related pain increases in tandem with age and musical experience (Gembris et al., 2020). A study investigating playing-related pain among music performance students found that 79% had a history of playing related physical pain. As much as 100% of percussionists reported such problems, as well as 84 to 87% of string, woodwind, keyboard, and brass players (Brandfonbrener, 2009). A recent study conducted in schools of music in the U.S (n = 1007) confirmed these levels of burden: 67% of the music students reported experiencing performance-related somatic symptoms (Stanek et al., 2017). PRMD is strongly associated with music performance anxiety and depression, and the burden is significantly worse for female music students than for male students (Kenny & Ackermann, 2015; Wristen & Fountain, 2013). In fact, ten out of twelve studies reported higher prevalence of musculoskeletal and somatic symptoms (e.g., headaches) among female musicians (Kok et al., 2015). When experiencing either PRMD or performance anxiety, music students tend to consult with their main instrument teachers before seeking help elsewhere (Williamon & Thompson, 2006). However, 44% of music students reports that their complaints of symptoms are not completely taken seriously, or not taken seriously at all (Gembris et al., 2020).

As shown, there is already extensive knowledge regarding the prevalence of somatic symptom burdens among both aspiring and professional musicians, as well as insights regarding various antecedents of maladaptive outcomes of somatic symptom burden. However, Motivational determinants of somatic symptom burden are less known and indeed understudied in the realm of music performance.

Self-Determination Theory and Basic Psychological Needs

Self-Determination Theory (SDT), which is one of the most cited contemporary theories of human motivation, has gained tremendous popularity since its conceptual introduction to the realm of music in 2015 (for review see Evans, 2015). SDT claims that human beings are inclined to explore, grow and overcome challenges in their continued aspirations (Deci & Ryan, 2000; Ryan & Deci, 2023). In order to reach homeostasis (i.e., state of physiological equilibrium) all living organisms are dependent on and inclined to search for environmental nutrients to fulfil basic physiological needs such as food, water, shelter and sex (Hull, 1952). Basic Psychological Needs Theory (BPNT), a sub-theory within the framework of SDT, refers to the satisfaction of psychological needs in a similar fashion claiming that optimal psychological functioning and nourishment is dependent on the satisfaction of three basic psychological needs, namely autonomy, relatedness and competence (Ryan & Deci, 2017; Ryan & La Guardia, 2000; Vansteenkiste et al., 2020). In essence, the need for autonomy is satisfied when individuals feel volitional and responsible for their own actions. Conversely, autonomy-frustration takes place when individuals feel controlled by other individuals and/or oneself, as well as through external rewards and punishment (Ryan & Deci, 2006). Furthermore, the need for relatedness is satisfied when individuals feel belongingness and cared for by others and frustrated when being dismissed and ignored by fellow human beings (Ryan & Powelson, 1991). The need for competence is

satisfied when individuals volitionally master and succeed in their aspirations. Lack of mastery and goal achievement are associated with competence-frustration (Ryan & Deci, 2017; Ryan & Moller, 2017).

Basic psychological needs are generally satisfied and frustrated based on the extent to which the environment is perceived as either autonomous or controlling. Individuals who aspire within an autonomously supportive environment thus perceive their actions as volitional and coherent with their sense of self and personally integrated with the activities and people at hand. Individuals aspiring within a controlling motivational climate are generally controlled by external rewards and/or punishment. The activities are thus unintegrated and external to the individual's self and carried out based on external or internal pressure (e.g., avoidance approaches). While autonomy support is generally a result of BPNS, controlled motivation is grounded on BPNF (Deci & Ryan, 2017). BPNS not only promotes health and well-being, but creativity, intrinsic motivation and the capacity to overcome and resist adversity (e.g., Calvo et al., 2010; Pope & Hall, 2015). On the other hand, BPNF is associated with psychopathological states such as depression, anxiety, social isolation, giving up and resilience skills and burn out (Deci & Ryan, 2000; Lemyre, 2005; Vansteenkiste & Ryan, 2013; Wei et al., 2005).

SDT is a relatively "new" theory within the realm of music that nonetheless has received increasing popularity over the last decade (Evans, 2015; e.g., Evans et al., 2013; Evans & Ryan, 2022). SDT research in music finds that BPNS promotes music students' well-being (e.g., Alessandri et al., 2020; Bailey, 2023; Blackwell et al., 2020; Kang & Yoo, 2019), positive career intentions to study music (Freer & Evans, 2018, 2019; Kingsford-Smith & Evans, 2021; Yoo, 2021), adaptive coping strategies for alleviating stress (Bonneville-Roussy et al., 2017), flow experience (Valenzuela et al., 2017), more frequent quality practice (Evans & Bonneville-

Roussy, 2015), and flourishing (Herrera et al., 2021). Considerably fewer studies in music have investigated BPNF as an independent construct. BPNF, however, has been associated with ceasing music both among adolescent music learners (Evans & McPherson, 2013) and elite performers in both music and sports (Hatfield, 2023), as well as less frequent quality practice (Evans & Bonneville-Roussy, 2015).

Basic psychological needs as a physiological determinant

Notably, basic psychological needs satisfaction and frustration (BPNSF) not only applies to psychological functioning, but to physiological (somatic) functioning and health as well (Deci et al., 2001; Ryan & Sapp, 2007). Research concerning effect of BPNSF on somatic symptom burden has mainly been carried out with the field of organizational psychology. For instance, Williams et al., (2014) found that employees' perceptions of managerial support for basic psychological needs were associated with lower levels of somatic symptom burden, which was in turn positively related to absenteeism, turnover intention, and emotional exhaustion. A study including 405 waiters/waitresses found that basic psychological needs for autonomy, competence, and relatedness were positively related to autonomous work motivation, which in turn were positively related to work performance and negatively related to somatic symptom burden (Olafsen & Halvari, 2017). Although support of autonomous motivation and decrease in amotivation/controlled motivation have been associated with positive changes in physical and psychological health outcomes in other professional domains (Ntoumanis et al., 2021).

To our surprise, and despite the physical demands of music practice and performance, research linking BPNSF and somatic symptom burden is scarce within the field of music.

General Life-Satisfaction

General life-satisfaction (GLS) refers to the extent to which individuals are happy and satisfied with regard to their personal perceptions of general life quality (Diener et al., 1985). As such, GLS is based on everyone's personal reference of high and low quality of life. Life satisfaction as a measure turns out to be stable over time and across cultures (Wristen, 2013). BPNS is linked to global life-satisfaction in myriad of studies within organizational psychology and sports (e.g., Komenda et al., 2022; Leversen et al., 2012; Unanue et al., 2017). This relation has received considerably less attention in the realm of music. Yet, some studies find that music students and professional musicians report lower levels of life satisfaction, as well as higher prevalence of anxiety and depression compared to the general population, often due to somatic symptom burden and symptoms of burnout (e.g., Alessandri et al., 2020; Vaag et al., 2016). Conversely, other studies have found that musicians score higher than the general population on positive emotions, relationships, meaning and well-being (Ascenso, 2022; Ascenso et al., 2018). A study among aspiring and professional musicians in Canada revealed that harmonious passion, as opposed to obsessive passion (for review see Vallerand, 2015), predicts GLS (Bonneville-Roussy & Vallerand, 2020). In addition, several studies, as mentioned above, BPNS positively to music students' well-being (e.g., Alessandri et al., 2020; Bailey, 2023; Blackwell et al., 2020; Kang & Yoo, 2019).

In this study, two items measuring giving up (i.e., giving up in response to challenges during music practice and performance) were used to assess potential negative outcomes. It was anticipated that GLS would correlate inversely with both BPNSF and giving up. Exploring these relationships in the context of higher music education may offer valuable insights into the role of BPNSF on coping (i.e., giving up or not in the face of adversity) and GLS, as well as

understanding better relations between symptom burden and giving up (e.g., Jang et al., 2016; Ryan & Moller, 2017).

The present study

Research questions

The principal question of importance in the present study is as follows:

What relations are there between respectively BPNS and BPNF, and somatic burden, giving up, and life satisfaction?

To account for the potential influence of background variables, the following research question complements the above research question, and the two hypotheses presented below:

To what extent is gender, instrument, practice hours, work status, sleep hours, study level, and study program associated with general life satisfaction, giving up (in the face of adversity), and somatic symptom burden?

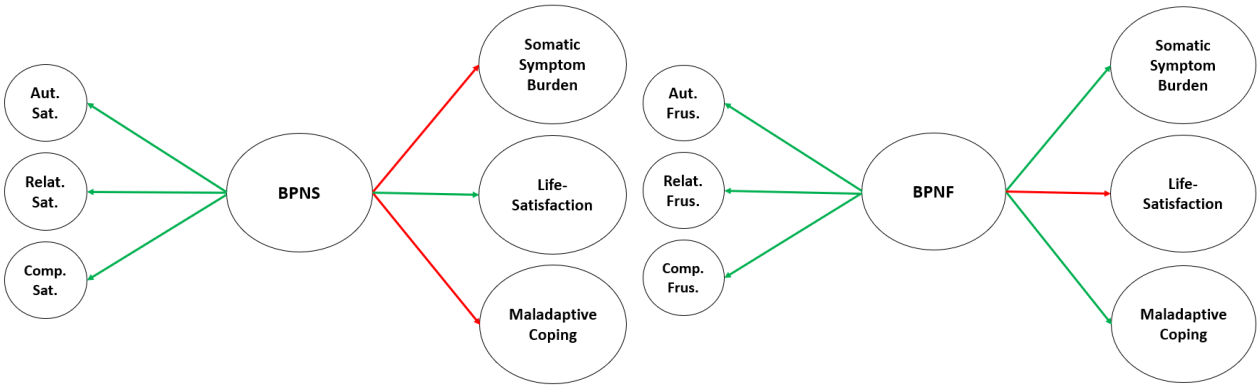
Hypotheses

Individuals pursuing musical activities for leisure report greater levels of BPNS, healthy aging and general well-being compared with individuals not taking part in such activities (Bailey, 2023; Koehler & Neubauer, 2020; Krause et al., 2019; Perkins & Williamon, 2014). These recreational reasons for engaging with music may contrast with performing music at a professional level where excellence is the ultimate goal (Haraldsen et al., 2020; Stabell, 2018; Williamon & Thompson, 2006). External expectations and competition, well manifested through BPNF, put considerable pressure and control on both aspiring and professional musicians (Dobson, 2011; Miksza et al., 2019; Palmer & Baker, 2021). Given that BPNF is linked to somatic symptom

burden in different professional work environments (Olafsen & Halvari, 2017; Williams et al., 2014), there are good reasons to believe that environmental pressure and control manifested through BPNF may impact not only aspiring professional musicians' mental health, but their somatic health and well-being as well. Interestingly, BPNS is generally associated with well-being, optimal functioning and flourishing among aspiring professional musicians (Evans & Ryan, 2022; Herrera et al., 2021), and negatively related to somatic symptom burden in different work contexts (e.g., Olafsen & Halvari, 2017). With this in mind, two hypotheses are tested (see Figure 1):

H1: BPNS is negatively associated with both somatic symptom burden and giving up, and positively associated with GLS.

H2: BPNF is positively associated with both somatic symptom burden and giving up, and negatively associated with GLS.



Figures 1a and 1b . Overview of The Two Hypotheses.

Note. Red arrows indicate significant negative predictive paths, green arrows indicate positive predictions. BPNS = Basic Psychological Need Satisfaction, BPNF = Basic Psychological Need Frustration.

Method

Participants

The present study is based on a large research project that was administered to music students in Scandinavia and England (for review see, blinded). The participants (n = 281) were aspiring professional musicians who attended music performance studies in Scandinavia and England. There were in total 55.2% women, 40.2% men, and 4.6% others. In this study, 65.2% of participants were bachelor students, 29.5% at master's level, and 5.3% pursuing diplomas or doctorates. Furthermore, 90.8% of music students reported practicing 1-7 hours daily (mean = 3.4 hours, SD = 1.4). Of these, 75.8% were enrolled in a Western classical music program, while the rest pursued studies in jazz, folk music, music education, or church music. The sample consisted of string players (26.4%), singers (19.2%), woodwind players (15.3%), brass players (12.1%), pianists (8.2%), guitarists (7.5%), percussionists (3.2%), organists (2.8%), harpists (1.4%), conductors (.7%) and other instruments (2.8%).

Procedure

In Spring 2022, music students from prominent Scandinavian and UK music conservatoires were invited to participate in an web based electronic survey provided by University of Oslo's www.nettskjema.no . This survey, initially distributed by the deans of these institutions, emphasized voluntary participation, anonymity, and the option to withdraw at any time. All responses from the UK were entered into a prize draw through which three prizes of vouchers at Amazon were offered. Participants received three follow-up reminders over a two-month availability period. Ethical approval was secured from the Norwegian Social Science Data Service (NSD) in Scandinavia and the Conservatoires UK (CUK) research ethics committee.

Measures

Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS). In this study, we employed a modified BPNSFS to gauge music students' perceptions of psychological need satisfaction and frustration within the context of higher music education (Chen et al., 2015; Olafsen et al., 2021). The BPNSFS was adapted for this specific demographic. The scale encompasses six subscales, each with four items, assessing satisfaction and frustration in three areas: autonomy, relatedness, and competence. The items were introduced in accordance with the context under investigation: "The following questions are related to your life as an aspiring musician and music student". Examples of adapted items include statements such as: "I feel I have been doing what really interests me" became "As a music student, I feel that I do what really interests me"; "I feel forced to do many things I wouldn't choose to do" became "As a music student, I feel forced to do many things I would not choose to do". The subscales demonstrated excellent internal consistency, with Cronbach's alpha values ranging between .82 and .93. Responses were collected using a 7-point Likert-type scale (1 = strongly disagree and 7 = strongly agree).

Somatic Symptom Burden (SSB). Six items were selected from the Patient Health Questionnaire PHQ-15 Scale (Kroenke et al., 2002) that were deemed suitable for the field of music performance. The scale was used to assess somatic symptom severity in relation to music practice and performance. The following questions were asked: "During the past 4 weeks, when practicing and/or performing, how much have you been bothered by any of the following problems?" The music students were asked to rate the extent to which they had been bothered by symptoms over the past four weeks, including (a) pain in the face, lips or mouth, (b) back pain, (c) pain in the arms, shoulders, or joints (elbow, fingers etc.), (d) pain caused by inflammation,

(e) headaches, and (f) trouble sleeping, all on a 3-point Likert-type scale (0 = 'not bothered at all', 1 = 'bothered a little', 2 = 'bothered a lot'). The scale showed a somewhat low, but acceptable internal reliability with a Cronbach's α of .61 (for review see Costello & Osborne, 2005).

Giving Up. This measure captures the extent to which music students tend to give up after repeated unsuccessful attempts of mastery in the context of music practice and performance. Two items were developed to capture this: "I usually give up when I'm not achieving the desired performance results" and "I usually give up when I repeatedly fail to perform difficult passages while practicing". The internal consistency for scale was good (α = .81). The scale was scored on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree).

The Satisfaction With Life Scale (SWLF). The SWLS is designed to measure global cognitive judgments of one's life satisfaction (Diener et al., 1985). The participants indicated their agreement to five statements about their life, such as "In most ways, my life is close to my ideal," using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The total score reflects an overall assessment of life satisfaction. This scale is not intended to assess satisfaction with specific life domains, such as health or finances, but rather an overall subjective evaluation of one's life. The internal consistency was excellent (Cronbach's α = .87).

Analytical procedures

The internal consistency of the data ranged from acceptable to excellent, with Cronbach's α between .61 and .93. The data were also far within acceptable measures for normality within structural equation modelling (SEM) including skewness less than 2.3 (Lei & Lomax, 2005), and kurtosis less than 7.0 [Byrne, 2016). Confirmatory Factor Analysis (CFA) was performed to assess how well two hypothesized higher order CFA models matched the sample data (Appendix

B1a and B2b). We applied standardized fit criteria established in the field of SEM (Hu & Bentler, 1999; Marsh, 1995). In our initial analysis, we regressed both the three need satisfaction and the three need frustration variables onto the three independent variables in a nine-factor solution. However, this solution revealed high collinearity between relatedness support and relatedness frustration (-.80) and between competence support and competence frustration (.80), distorting parameter estimates and making it difficult to disentangle their effects on the outcome variables. As a result, most predictors became non-significant despite moderate to strong associations in bivariate analyses (see Table 2). The same collinearity issue emerged in the second-order model (.91) between BPNS and BPNF as predictors. Given that BPNS and BPNF are theoretically supported as distinct constructs (Chen et al., 2015; Olafsen et al., 2021), we opted to present them in separate models to better capture their individual contributions to the outcome variables. The two second order models evaluating 1) students' perceptions of BPNS, and 2) BPNF, showed a strong fit with the underlaying data (see Table 1). Factor loadings between manifest variables (i.e., the single items in a questionnaire) and the latent construct (i.e., all six items related to somatic symptom burden) in CFA measure how well the manifest variables reflect the underlying latent construct. Factor loadings where within an acceptable range between .42 and .93 for Model 1, and between .40 and .90 for Model 2 (Hair, 2009; Tabachnick & Fidell, 2013)[1]. The item pain1 exhibited a somewhat lower factor loading in both CFA models (.32; .31). However, it was considered theoretically relevant for maintaining construct variance across all participants,

[1] A factor loading of 0.41 indicates a moderate relationship between the item and the underlying factor. While it suggests that the item contributes to the construct, it also implies that a significant portion of the item's variance is not explained by the factor. A factor loading of 0.90 reflects a very strong relationship between the item and the latent factor, meaning that the item is a highly reliable indicator of the construct and shares a large proportion of its variance with the underlying factor.

including specific subgroups such as wind instrument players who may experience pain in the face, lips, and/or mouth. Moreover, the model fit the data well (for review see Table 2).

The two hypotheses were further tested through two structural models (i.e., SEM models). The two structure models demonstrated acceptable to good model fit with the underlaying data (Table 1). Furthermore, background variables such as gender, instrument, practice hours, country, work status, sleep hours, study level, and study program were included as control variables. Hence, these variables were modelled as predictors of the dependent lant constructs (i.e., somatic symptom burden, life satisfaction, and giving up) ensuring that their potential confounding effects were accounted for (see Tables 1 and 3). By incorporating these controls, the analysis aimed to isolate the unique relationships between the primary variables of interest while mitigating biases arising from demographic and contextual factors. For further review see Appendices B1a, B1b, B2a and B2b depicting the CFA and SEM models with latent, observed and control variables. Analyses were conducted through IBM SPSS 30 and IBM Amos version 28**.**

Table 1. Fit indices for both CFA and SEM models.

Model	$\chi 2$	df	p	$\chi 2$/df	IFI	CFI	RMSEA
CFA model 1 (BPNS)	359.01	264	<.001	1.36	.98	.98	.036
CFA model 2 (BPNF)	389.65	263	<.001	1.48	.96	.96	.041
SEM model 1 (BPNS)	623.09	434	<.001	1.43	.96	.96	.039
SEM model 2 (BPNF)	735.11	434	<.001	1.69	.91	.91	.050

Note. The SEM and CFA results were based on fit indices for model identification and hypothesis testing based on the following (Hu & Bentler, 1999; Marsh, 1995): Chi-square ($\chi 2$), the Comparative Fit Index and the Incremental Fit Index (CFI and IFI > 0.95 indicates a well-fitting model, and values > 0.90 indicates acceptable model fit), and the Root Mean Square Error of Approximation (RMSEA < 0.06 yields a good model fit, and < 0.08 indicates an acceptable-fitting model).

Results

Descriptive and bivariate findings

The initial data analysis revealed that music students in general report a high score on BPNS (*M* = 4.95; 5.27; 4.98), and generally low mean scores on BPNF (*M* = 3.53; 2.27; 3.45). Further, a majority of the sample reported close to average mean measures on general life-satisfaction (*M* = 4.27). Students were generally low in giving up when facing difficulties (*M* = 2.48). For further review see Table 2. With regard to the Pearson's correlations, satisfaction of all the three needs were moderately to strongly correlated to life-satisfaction (r = .42, .44 and .50, p <.001). Frustration of the three needs are negatively correlated with life-satisfaction, demonstrating opposite trends (r = -.25, -.31 and -.44, p <.001). Further, moderate negative correlations between autonomy and competence satisfaction and giving up in the fae of failure were found (r = -.22, -.31 and -.45, p <.001). Thus, the higher satisfaction for competence and autonomy reported, the lower scores reported in regard to giving up when facing difficulties in instrumental practice and performance. On the other hand, Competence frustration was moderately and positively correlated to giving up (r = .44, p <.001), and to somatic symptom burden (r = .35, p <.001; the higher competence frustration reported, the higher scores on both somatic symptom burden and on giving up in the face of failure). Finally, a moderate correlation was found between autonomy frustration and somatic symptom burden (r = .25, p <.001; for further review see Table 2 and Appendix A.

Table 2. Descriptive statistics and Pearsons's correlations between study variables

Variable	1	2	3	4	5	6	7	8	9	M	SD	Skew	Kurt.
1. Autonomy Satisfaction	--									4.95	1.24	-0.35	-0.49
2. Autonomy Frustration	-.39**	--								3.53	1.34	0.27	-0.52
3. Relatedness Satisfaction	.26**	-.15*	--							5.27	1.50	-0.91	0.13
4. Relatedness Frustration	-.18**	.26**	-.69**	--						2.18	1.24	1.45	2.12
5. Competence Satisfaction	.56**	-.32**	.40**	-.30**	--					4.98	1.40	-0.58	-0.19
6. Competence Frustration	-.41**	.44**	-.33**	.36**	-.72**	--				3.45	1.59	0.35	-0.84
7. Somatic Symptom Burden	-.18**	.26**	-.07	.18**	-.24**	.35**	--			1.63	0.39	0.50	-0.33
8. Life Satisfaction	.44**	-.25**	.42**	-.31**	.50**	-.44**	-.18**	--		4.27	1.36	-0.26	-0.50
9. Giving Up	-.31**	.24**	-.22**	.24**	-.45**	.42**	.12**	-.27**	--	2.48	1.29	1.06	0.64

Note. * = $p < .05$, ** = $p < .001$. All correlations are Pearson's r coefficients spanning between – 1 to 1.
Correlations between .10 to .30 = Weak, .30 to .50 = Moderate, .50 to .80 = Strong.
M = Mean, SD = Stand Deviation

Several students reported that they struggle with somatic symptom burden. Back pain, and pain in arms, shoulders and joints, as well as headaches and trouble sleeping were the most pronanced burdens reported (Figure 2).

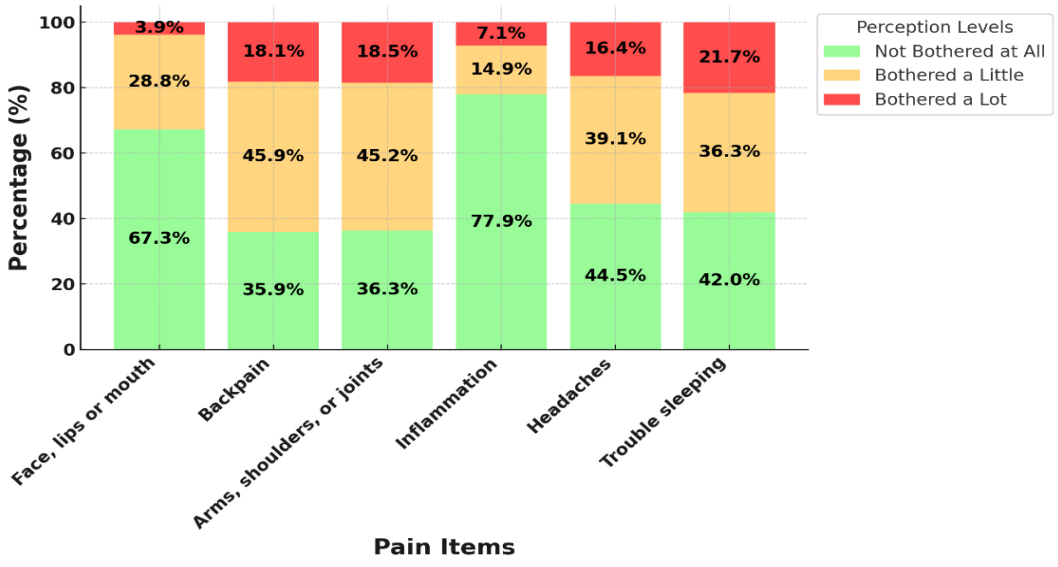


Figure 2. Distribution of Perception Levels by Somatic Symptom Burden Items

Note. Each bar segment represents the proportion of responses for each symptom burden level: "Not Bothered at All" (green), "Bothered a Little" (yellow/orange), and "Bothered a Lot" (red).

Primary findings

The results support H1: BPNS showed a significant negative association with somatic symptom burden (β = -0.35, p < .001) and giving up (β = -0.56, p < .001), indicating that higher BPNS is linked to lower levels of both somatic symptoms and giving up. Additionally, BPNS demonstrated a positive strong association with GLS (β = 0.70, p < .001), confirming that greater BPNS is associated with enhanced life satisfaction (Table 3a).

The findings support H2: BPNF exhibited a positive association with somatic symptom burden (β = 0.48, p < .001) and giving up (β = 0.52, p < .001), suggesting that higher BPNF corresponds to increased somatic symptoms and giving up. Furthermore, BPNF was negatively associated with GLS (β = -0.57, p < .001), indicating that greater need frustration is linked to reduced life satisfaction (Table 3b).

Table 3a. Regression Results for the Structural Equation Model 1 (BPNS)

Independent Variables ⟶	Somatic Symptoms (β)	Life Satisfaction (β)	Giving Up (β)
Independent Variable			
BPNS	-0.348**	0.705**	-0.556**
Control Variables			
Work status	-0.212*	-0.013	-0.031
Instrument	-0.035	-0.014	-0.054
Country	-0.118†	0.019	-0.024
Gender	-0.052	-0.026	-0.098
Practice hours	0.172*	-0.082	-0.113†
Sleep hours	-0.226**	0.046	-0.113
Study level	-0.113†	-0.003	-0.102†
Study program	-0.023	0.024	-0.049
R^2	0.284	0.505	0.331

Note. Standardized regression coefficients (β) are reported. BPNS = Basic Psychological Needs Satisfaction. Somatic Symptoms, Life Satisfaction, and Giving Up are the dependent variables.
* = p < .05, ** = p < .001, † = p < .10.

Table 3b. Regression Results for the Structural Equation Model 2 (BPNF)

Independent Variables ⟶	Somatic Symptoms (β)	Life Satisfaction (β)	Giving Up (β)
Independent Variable			
BPNF	0.489**	-0.567**	0.522**
Control Variables			
Work status	-0.210*	-0.095	0.026
Instrument	0.003	-0.069	-0.002
Country	-0.109†	0.013	-0.010
Gender	-0.031	-0.012	-0.094
Practice hours	0.180*	-0.083	-0.126*
Sleep hours	-0.199**	0.085	-0.072
Study level	-0.107†	-0.007	-0.087
Study program	-0.033	0.020	-0.043
R^2	0.386	0.374	0.323

Note. Standardized regression coefficients (β) are reported. BPNF = Basic Psychological Need Frustration. Somatic Symptoms, Life Satisfaction, and Giving Up are the dependent variables.
* = p < .05, ** = p < .001, † = p < .10.

Control variables: The results revealed that control variables generally did not have a significant effect on the direction and strength of the independent variables (i.e., BPNS and BPNF) in the dependent variables (i.e., somatic symptoms, life satisfaction, and giving up), however, there were a few exceptions (Table 3a and 3b). First, work status had a moderate negative association to somatic pain (β = -0.21, p < .05), indicating that participants who were working besides studying music were less likely to report somatic burdens. Second, the more practice hours reported, the greater chance of reporting somatic symptoms (β = 0.18, p < .05). However, participants who reported practicing for 3 hours or more were marginally less likely to give up when facing difficulties in their practice and music performance (β = - 0.13, p < .05). Finally, sleep hours were associated with a lower likelihood of experiencing somatic symptom burden (i.e., the more sleep reported the less likely participants were to report somatic symptom burdens). This was also the case after removing the item related to trouble sleeping (i.e., Pain6; β = - 0.22, p < .001).

Explained variance: In model 1, the BPNS model, the explained variance was R^2 = .28 for somatic symptom burden, R^2 = .51 for life satisfaction, and R^2 = .33 for giving up in the face of failure. In model 2, the BPNF model, the explained variance was higher for somatic symptom burden, R^2 = .39, while life satisfaction and giving up in the face of failure had an explained variance of R^2 = .37 and R^2 = .32. These values suggest that *BPNF* is more strongly associated with Somatic Symptom Burden, whereas *BPNS* shows a stronger relationship with life-satisfaction (Table 3a and 3b).

Discussion

The influence of basic psychological needs on somatic symptom burden

The relationship between basic psychological needs satisfaction (BPNS), needs frustration (BPNF), and somatic symptom burden remains an under-researched area within performance science. Addressing this gap, the present study found that aspiring professional musicians whose basic psychological needs were satisfied were less likely to experience playing-related somatic symptoms compared to those whose basic psychological needs were frustrated. On average, participants demonstrated higher scores in BPNS than in BPNF, and BPNF showed a stronger association with somatic symptom burden than BPNS. Specifically, autonomy and competence frustration had the strongest correlations with somatic symptoms and accounted for the highest levels of explained variance in outcomes. Although frustration of the need for relatedness was also positively correlated with somatic burden, this association was comparatively weaker. On the other hand, autonomy and competence satisfaction were negatively correlated with somatic symptom burden, which corresponds to previous findings in organizational psychology (Olafsen & Halvari, 2017; Williams et al., 2014).

Possible links between BPNSF and somatic burden

Although this study does not establish causality, the results suggest that participants perceiving a predominantly controlling work environment—characterized by external and internal pressures—might be at a higher risk of developing somatic symptoms compared to participants perceiving higher music education as autonomy-supportive. Yet, it is also possible that somatic symptom burden predominantly contributes to a perceived lack of competence and autonomy and thereby a lack of belonging (e.g., hiding weaknesses through avoidance behaviors). The links between BPNF and somatic burden may also be bidirectional: a demanding, controlling environment may exacerbate somatic symptoms, which, in turn, may lead to psychological need frustration and further physiological stress (and the other way around concerning BPNS). Notably, the findings suggest that an autonomy-supportive motivational climate, which fulfills basic psychological needs, could foster both physical and psychological health in aspiring musicians (Evans & Ryan, 2022). The complexity and directionality of these relationships remain inconclusive and deserve more attention in future research.

Possible cofactors of BPNSF contributing to somatic symptom burden

A significant proportion of participants reported a considerable somatic burden, over 18% of the participants reported that they are bothered a lot with both back pain, and pain in their arms, shoulders, and joints. An additional 45% of the students expressed that they were slightly troubled by these physical ailments. However, despite experiencing these pain symptoms, participants reported an average of 3.5 hours of daily practice, suggesting that music students persist in practice and performance even when in discomfort (Robitaille et al., 2015; Stanek et al., 2017). The lowest mean score in this study was accordingly observed in giving up, indicating that

these aspiring professional musicians generally demonstrate resilience and persistence when facing aversity. Moreover, a high-pressure environment may foster a "no pain, no gain" mentality, potentially leading to BPNF, insufficient rest, and inadequate injury prevention (Hatfield & Lemyre, 2016; Kreutz et al., 2008; Lehmann & Jørgensen, 2012). In fact, participants practicing three hours or more daily were more likely to report higher levels of somatic symptom burden than those practicing less than three hours. Furthermore, participants who reported sleeping seven hours or more were less likely to experience somatic symptoms than participants sleeping five to six hours per night. Additionally, female participants demonstrated higher mean scores for somatic burden and were marginally more likely to report symptom burdens than their male counterparts, consistent with previous studies (Kenny & Ackermann, 2015; Kok et al., 2015; Wristen, 2013; Wristen & Fountain, 2013). These findings indicate the complexity of BPNSF-somatic symptom burden relationship and the number of factors that contribute to somatic symptom burden and lack thereof.

BPNSF, Somatic Burden, and Life Satisfaction

The study revealed that participants whose basic psychological needs were met also reported high levels of general life satisfaction (GLS), a finding consistent with previous studies (Diseth et al., 2012; Unanue et al., 2017). Notably, 50% of the variance in GLS was explained by BPNS. Conversely, participants with high levels of BPNF reported lower levels of general life satisfaction, with 37% of the variance explained by BPNF. This is an important finding which suggests that satisfaction and frustration of basic psychological needs may determine the extent to which music students are satisfied with life both within and outside higher music education. As anticipated, somatic symptom burden and life satisfaction were negatively correlated, suggesting that the discomfort from somatic symptoms may extend beyond physical pain possibly impacting

overall well-being and happiness with life in general. Both these observations highlights the possible far-reaching impact of BPNSF and somatic burden on various aspects life (Kenny & Ackermann, 2015; Lamontagne & Bélanger, 2015), as well as the potentially constructive quality of an educational context highlighting autonomy-support at its core (Bonneville-Roussy et al., 2020; Butler, 2022; Evans et al., 2013).

The Role of BPNSF in Giving Up

Participants reporting high levels of BPNS were more likely to persist in the face of failure, whereas those with high levels of BPNF demonstrated reduced resilience when confronted with repeated setbacks. Given the cross-sectional nature of this study, it is also possible that giving up may contribute to BPNF, which could, in turn, be influenced by somatic symptom burden. Notably, giving up was weakly and positively correlated with somatic symptom burden, suggesting that somatically burdened students might choose to withdraw rather than endure ongoing discomfort. More research is needed to elucidate the ways in which various coping mechanisms, BPNSF, and somatic burden interact and influence one another. The overarching findings of this study suggest that BPNS may be a significant precursor to preventing somatic burden and fostering life satisfaction and resilience. Overall, these results underscore the importance of a learning environment that nurtures BPNS, thereby promoting autonomous self-regulation among music students. (Evans & Ryan, 2022; Hatfield, 2018; Reeve et al., 2008).

Limitations

The present study's design and methodology have several limitations. First, while the study included 281 music performance students, a sample size deemed acceptable according to SEM standards (Byrne, 2016), its generalizability to all music students is limited due to the

convenience sampling method used (Tabachnick & Fidell, 2013). Future research would benefit from randomized sampling to broaden the applicability of the findings. Second, the study's cross-sectional nature precludes causal conclusions between variables. However, the research is theoretically underpinned, allowing for theoretical causality based on expertise and prior research (Black et al., 2010). Third, the study does not deeply explore individual students' perceptions. Future research could be strengthened by employing mixed-methods designs, which would complement quantitative results with qualitative insights (Creswell, 2009). Fourth, although students were asked to report somatic symptoms specifically while practicing or performing, including an item assessing potential somatic pain outside of music performance would have improved the face validity of the somatic symptom burden construct. Thus, to distinguish between playing-related pain and possible other causes of pain development, future studies should to a greater extent assess participants' perceptions of pain history and the distinct pain cause. The six items from PHQ-15 measuring somatic symptom burden had a poor internal consistency (Cronbach's α = .61). We believe that future studies should consider applying The Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (Berque et al., 2014), which explicitly target perceived pain cause and the exact location of musculoskeletal pain in musicians. Finally, future studies employing longitudinal and interventional designs could yield valuable insights into directionality, causal effects, and temporal changes among these variables.

Conclusion and educational implications

In higher music education, aspiring musicians encounter both overt and subtle pressures and expectations to excel and showcase exceptional performance. This study reveals a significant role of the satisfaction and frustration of basic psychological needs in the extent to which students

experience somatic symptoms related to performance. It was found that students who have their needs satisfied are less prone to these symptoms. Conversely, need-frustration was closely linked to an increased burden of somatic symptoms in both practice and performance situations. This correlation between BPNSF and somatic symptom burden has not been previously established, indicating novel implications for educators and students. Therefore, educators are advised to assist students burdened with somatic symptoms in identifying and altering unproductive practice and performance patterns, encouraging the adoption of constructive and personally relevant goals (Hatfield, 2018). This study is the first to investigate interrelations between BPNSF and various factors including somatic symptom burden, giving up, and general life satisfaction. The findings underscore the educational importance of understanding and applying the central principles of SDT. As such, we suggest that educators, administrators, as well as students can potentially mitigate somatic symptoms and simultaneously promote life satisfaction by integrating principles of basic psychological needs theory into teaching and learning (for review see Deci & Ryan, 2000; Evans & Ryan, 2022; Reeve et al., 2008). This involves addressing the negative effects of excessive competition and control, while creating a learning environment that is open, transparent, and collaborative that fosters autonomy-support and need-satisfaction (Jang et al., 2016; Ntoumanis et al., 2021; Ryan & Deci, 2017). Given the lack of prior research establishing associations between BPNSF and somatic symptoms in music, we call for more research to explore the nuances and causal links between basic psychological needs and somatic well-being.

References

Alessandri, E., Rose, D., & Wasley, D. (2020). Health and wellbeing in higher education: A comparison of music and sport students through the framework of self-determination theory. *Frontiers in Psychology, 11*, Article 566307. DOI: https://doi.org/10.3389/fpsyg.2020.566307.

Ascenso, S. (2022). Musicians' wellbeing: A cross-sectional investigation within the framework of Positive Psychology. Royal College of Music. DOI: https://doi.org/10.24379/RCM.00002247.

Ascenso, S., Perkins, R., & Williamon, A. (2018). Resounding meaning: A PERMA wellbeing profile of classical musicians. *Frontiers in Psychology, 9*, Article 1895. DOI: https://doi.org/10.3389/fpsyg.2018.01895.

Bailey, E. N. (2023). University music ensemble participation and psychological well-being. *Contributions to Music Education, 48*, 99–119.

Berque, P., Gray, H. & McFadyen, A. 2014, "Development and psychometric evaluation of the Musculoskeletal Pain Intensity and Interference Questionnaire for professional Musicians.", *Manual Therapy*, vol. 19, pp. 575-588. http://dx.doi.org/10.1016/j.math.2014.05.015.

Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective*. Pearson.

Blackwell, J., Miksza, P., Evans, P., & McPherson, G. E. (2020). Student vitality, teacher engagement, and rapport in studio music instruction. *Frontiers in Psychology, 11*, Article 1007. DOI: https://doi.org/10.3389/fpsyg.2020.01007.

Bonneville-Roussy, A., Evans, P., Verner-Filion, J., Vallerand, R. J., & Bouffard, T. (2017). Motivation and coping with the stress of assessment: Gender differences in outcomes for university students. *Contemporary Educational Psychology, 48*, 28–42. DOI: https://doi.org/10.1016/j.cedpsych.2016.08.003.

Bonneville-Roussy, A., Hruska, E., & Trower, H. (2020). Teaching music to support students: How autonomy-supportive music teachers increase students' well-being. *Journal of Research in Music Education, 68*(1), 97–119. DOI: https://doi.org/10.1177/0022429419897611.

Bonneville-Roussy, A., & Vallerand, R. J. (2020). Passion at the heart of musicians' well-being. *Psychology of Music, 48*(2), 266–282. DOI: https://doi.org/10.1177/0305735618797180.

Brandfonbrener, A. G. (2009). History of playing-related pain in 330 university freshman music students. *Medical Problems of Performing Artists, 24*(1), 30–36. DOI: https://doi.org/10.21091/mppa.2009.1007.

Butler, T. (2022). Autonomy-supportive teaching in the large ensemble: Positive outcomes for student motivation and teacher satisfaction. *Music Educators Journal, 108*(4), 31–36. DOI: https://doi.org/10.1177/00274321221107537.

Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming.* Routledge. DOI: https://doi.org/10.4324/9781315757421.

Calvo, T. G., Cervelló, E., Jiménez, R., Iglesias, D., & Murcia, J. A. M. (2010). Using self-determination theory to explain sport persistence and dropout in adolescent athletes. *The Spanish Journal of Psychology, 13*(2), 677–684. DOI: https://doi.org/10.1017/S1138741600002262.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., Duriez, B., Lens, W., Matos, L., & Mouratidis, A. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion, 39*, 216–236. DOI: https://doi.org/10.1007/s11031-014-9450-1.

Costello, A., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1–9. DOI: https://doi.org/10.7275/jyj1-4868.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage Publications.

Cruder, C., Barbero, M., Koufaki, P., Soldini, E., & Gleeson, N. (2020). Prevalence and associated factors of playing-related musculoskeletal disorders among music students in Europe. *PLoS One, 15*(12), e0242660. DOI: https://doi.org/10.1371/journal.pone.0242660.

Deci, E. L., & Ryan, R. M. (2000). The "What" and "Why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227–268. DOI: https://doi.org/10.1207/S15327965PLI1104_01.

Deci, E. L., Ryan, R. M., Gagné, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former Eastern Bloc country. *Personality and Social Psychology Bulletin, 27*(8), 930–942. DOI: https://doi.org/10.1177/0146167201278002.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment, 49*(1), 71–75. DOI: https://doi.org/10.1207/s15327752jpa4901_13.

Diseth, Å., Danielsen, A. G., & Samdal, O. (2012). A path analysis of basic need support, self-efficacy, achievement goals, life satisfaction and academic achievement level among secondary school students. *Educational Psychology, 32*(3), 335–354. DOI: https://doi.org/10.1080/01443410.2012.657159.

Dobson, M. C. (2011). Insecurity, professional sociability, and alcohol: Young freelance musicians' perspectives on work and life in the music profession. *Psychology of Music, 39*(2), 240–260. DOI: https://doi.org/10.1177/0305735610373562.

Evans, P. (2015). Self-determination theory: An approach to motivation in music education. *Musicae Scientiae, 19*(1), 65–83. DOI: https://doi.org/10.1177/1029864914568044.

Evans, P., & Bonneville-Roussy, A. (2015). Self-determined motivation for practice in university music students. *Psychology of Music, 43*(6), 720–737. DOI: https://doi.org/10.1177/0305735615610926.

Evans, P., McPherson, G. E., & Davidson, J. W. (2013). The role of psychological needs in ceasing music and music learning activities. *Psychology of Music, 41*(5), 600–619. DOI: https://doi.org/10.1177/0305735612441736.

Evans, P., & Ryan, R. M. (2022). Intrinsic and extrinsic motivations for music performance. In G. E. McPherson (Ed.), *The Oxford Handbook of Music Performance*, Volume 1 (pp. 1–24). Oxford University Press. DOI: https://doi.org/10.1093/oxfordhb/9780190056285.013.24.

Freer, E., & Evans, P. (2018). Psychological needs satisfaction and value in students' intentions to study music in high school. *Psychology of Music, 46*(6), 881–895. DOI: https://doi.org/10.1177/0305735617731613.

Freer, E., & Evans, P. (2019). Choosing to study music in high school: Teacher support, psychological needs satisfaction, and elective music intentions. *Psychology of Music, 47*(6), 781–799. DOI: https://doi.org/10.1177/0305735619864634.
Gembris, H., Menze, J., Heye, A., & Bullerjahn, C. (2020). High-performing young musicians' playing-related pain: Results of a large-scale study. *Frontiers in Psychology, 11*, Article 564736. DOI: https://doi.org/10.3389/fpsyg.2020.564736.
Haraldsen, H. M., Nordin-Bates, S. M., Abrahamsen, F. E., & Halvari, H. (2020). Thriving, striving, or just surviving? TD learning conditions, motivational processes, and well-being among Norwegian elite performers in music, ballet, and sport. *Roeper Review, 42*(2), 109–125. DOI: https://doi.org/10.1080/02783193.2020.1728796.
Hatfield, J. L. (2018). Goal setting and self-determination in music making: Tenets of becoming an organized and motivated music practitioner. *Nordic Research in Music Education Yearbook, 18*, 271–294. DOI: https://hdl.handle.net/11250/2490529.
Hatfield, J. L. (2023). Determinants of motivation in world-class musicians and Olympic athletes: Exploring the front and the back side of the medallion. *Psychology of Music*. DOI: https://doi.org/10.1177/03057356231155973.
Hatfield, J. L., & Lemyre, P.-N. (2016). Foundations of intervention research in instrumental practice. *Frontiers in Psychology, 6*, Article 02014. DOI: https://doi.org/10.3389/fpsyg.2015.02014.
Herrera, D., Matos, L., Gargurevich, R., Lira, B., & Valenzuela, R. (2021). Context matters: Teaching styles and basic psychological needs predicting flourishing and perfectionism in university music students. *Frontiers in Psychology, 12*, Article 623312. DOI: https://doi.org/10.3389/fpsyg.2021.623312.
Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. DOI: https://doi.org/10.1080/10705519909540118.
Jang, H., Reeve, J., & Halusic, M. (2016). A new autonomy-supportive way of teaching that increases conceptual learning: Teaching in students' preferred ways. *The Journal of Experimental Education, 84*(4), 686–701. DOI: https://doi.org/10.1080/00220973.2015.1083522
Jørgensen, H., & Lehmann, A. C. (1997). Does practice make perfect? *NMH Publikasjoner, 1*, 71–88.
Kang, S., & Yoo, H. (2019). Music teachers' psychological needs and work engagement as predictors of their well-being. *Bulletin of the Council for Research in Music Education*, (221), 58–71. DOI: https://doi.org/10.5406/bulcouresmusedu.221.0058.
Kenny, D., & Ackermann, B. (2015). Performance-related musculoskeletal pain, depression, and music performance anxiety in professional orchestral musicians: A population study. *Psychology of Music, 43*(1), 43–60. DOI: https://doi.org/10.1177/0305735613493953.
Kingsford-Smith, A., & Evans, P. (2021). A longitudinal study of psychological needs satisfaction, value, achievement, and elective music intentions. *Psychology of Music, 49*(3), 382–398. DOI: https://doi.org/10.1177/0305735619868285.
Koehler, F., & Neubauer, A. B. (2020). From music making to affective well-being in everyday life: The mediating role of need satisfaction. *Psychology of Aesthetics, Creativity, and the Arts, 14*(4), 493–505. DOI: https://doi.org/10.1037/aca0000261.
Kok, L. M., Huisstede, B. M., Voorn, V. M., Schoones, J. W., & Nelissen, R. G. (2016). The occurrence of musculoskeletal complaints among professional musicians: A systematic

review. *International Archives of Occupational and Environmental Health, 89*, 373–396. DOI: https://doi.org/10.1007/s00420-015-1090-6.

Kok, L. M., Nelissen, R., & Huisstede, B. M. A. (2015). Prevalence and consequences of arm, neck, and/or shoulder complaints among music academy students: A comparative study. *Medical Problems of Performing Artists, 30*(3), 163–168. DOI: https://doi.org/10.21091/mppa.2015.3031.

Komenda, S., Springstein, T., Zrnić, I., Zeilinger, E., Franken, F., & Weber, G. (2022). Satisfaction with life in Special Olympic athletes: The role of autonomy support and basic need fulfillment. *International Journal of Developmental Disabilities, 68*(6), 964–972. DOI: https://doi.org/10.1080/20473869.2021.1917110

Krause, A. E., North, A. C., & Davidson, J. W. (2019). Using self-determination theory to examine musical participation and well-being. *Frontiers in Psychology, 10*, Article 405. DOI: https://doi.org/10.3389/fpsyg.2019.00405.

Kreutz, G., Ginsborg, J., & Williamon, A. (2008). Music students' health problems and health-promoting behaviours. *Medical Problems of Performing Artists, 23*(1), 3–11. DOI: https://doi.org/10.21091/mppa.2008.1002

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2002). The PHQ-15: Validity of a new measure for evaluating the severity of somatic symptoms. *Psychosomatic Medicine, 64*(2), 258–266. DOI: https://doi.org/10.1097/00006842-200203000-00008.

Lamontagne, V., & Bélanger, C. (2015). Pain-related and performance anxiety and their contribution to pain in music students: A pilot study. *Health Psychology Report, 3*(1), 59–68. DOI: https://doi.org/10.5114/hpr.2015.47088

Lehmann, Andreas C., and Harald Jørgensen, ' Practice', in Gary E. McPherson, and Graham F. Welch (eds), *The Oxford Handbook of Music Education, Volume 1*, Oxford Handbooks (2012; online edn, Oxford Academic, 6 Nov. 2012), https://doi.org/10.1093/oxfordhb/9780199730810.013.0041

Leversen, I., Danielsen, A. G., Birkeland, M. S., & Samdal, O. (2012). Basic psychological need satisfaction in leisure activities and adolescents' life satisfaction. *Journal of Youth and Adolescence, 41*, 1588–1599. DOI: https://doi.org/10.1007/s10964-012-9776-5.

Marsh, H. W. (1995). 2 and χ2 fit indices for structural equation models: A brief note of clarification. *Structural Equation Modeling, 2*, 246–254. DOI: https://doi.org/10.1080/10705519509540026.

Miksza, P., Evans, P., & McPherson, G. E. (2019). Motivation to pursue a career in music: The role of social constraints in university music programs. *Psychology of Music, 49*(1), 50–68. DOI: https://doi.org/10.1177/0305735619836269.

Ntoumanis, N., Ng, J. Y. Y., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Lonsdale, C., & Williams, G. C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: Effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review, 15*(2), 214–244. DOI: https://doi.org/10.1080/17437199.2020.1718529.

Olafsen, A. H., & Halvari, H. (2017). Motivational mechanisms in the relation between job characteristics and employee functioning. *The Spanish Journal of Psychology, 20*, Article E38. DOI: https://doi.org/10.1017/sjp.2017.34.

Olafsen, A. H., Halvari, H., & Frølund, C. W. (2021). The Basic Psychological Need Satisfaction and Need Frustration at Work Scale: A validation study. *Frontiers in Psychology, 12*, Article 697306. DOI: https://doi.org/10.3389/fpsyg.2021.697306.

Palmer, T., & Baker, D. (2021). Classical soloists' life histories and the music conservatoire. *International Journal of Music Education, 39*(2), 167–186. DOI: https://doi.org/10.1177/0255761421991154.

Perkins, R., & Williamon, A. (2014). Learning to make music in older adulthood: A mixed-methods exploration of impacts on wellbeing. *Psychology of Music, 42*(4), 550–567. DOI: https://doi.org/10.1177/0305735613483668.

Pope, J. P., & Hall, C. (2015). Understanding the relationship between coaches' basic psychological needs and identity prominence and their commitment, positive affect, and intentions to persist. *The Sport Psychologist, 29*(2), 134–142. DOI: https://doi.org/10.1123/tsp.2014-0037

Reeve, J., Ryan, R. M., Deci, E. L., & Jang, H. (2008). Understanding and promoting autonomous self-regulation: A self-determination perspective. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and Self-Regulated Learning: Theory, Research, and Applications* (pp. 223–244). Lawrence Erlbaum Associates.

Rickert, D. L., Barrett, M. S., & Ackermann, B. J. (2015). Are music students fit to play? A case study of health awareness and injury attitudes amongst tertiary student cellists. *International Journal of Music Education, 33*(4), 426–441. DOI: https://doi.org/10.1177/0255761415582343.

Robitaille, J., Guay, M., & Tousignant-Laflamme, Y. (2015). Description of playing-related musculoskeletal pain in elite string students. *International Musculoskeletal Medicine, 37*(3), 125–131. DOI: https://doi.org/10.1179/1753615415Y.0000000008

Rotter, G., Noeres, K., Fernholz, I., Willich, S. N., Schmidt, A., & Berghöfer, A. (2020). Musculoskeletal disorders and complaints in professional musicians: A systematic review of prevalence, risk factors, and clinical treatment effects. *International Archives of Occupational and Environmental Health, 93*, 149–187. DOI: 10.1007/s00420-019-01467-8

Ryan, R. M., & Deci, E. L. (2006). Self- regulation and the problem of human autonomy: Does psychology need choice, self- determination, and will? *Journal of Personality, 74*(6), 1557–1586. DOI: https://doi.org/10.1111/j.1467-6494.2006.00420.x.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness.* Guilford Publications. DOI: https://doi.org/10.1521/978.14625/28806

Ryan, R. M., & Deci, E. L. (2023). Acting as one: Self-determination theory's scientific and existential import. In *The Oxford Handbook of Self-Determination Theory* (pp. 1173–1176). Oxford University Press. DOI: https://doi.org/10.1093/oxfordhb/9780197600047.013.59.

Ryan, R. M., & La Guardia, J. G. (2000). What is being optimized? Self-determination theory and basic psychological needs. *Motivation and Emotion, 24*, 27–46. DOI: https://doi.org/10.1037/10363-008

Ryan, R. M., & Moller, A. C. (2017). Competence as central, but not sufficient, for high-quality motivation. In *Handbook of Competence and Motivation: Theory and Application* (pp. 216–238). Guilford Press.

Ryan, R. M., & Powelson, C. L. (1991). Autonomy and relatedness as fundamental to motivation and education. *The Journal of Experimental Education, 60*(1), 49–66.

Ryan, R. M., & Sapp, A. R. (2007). Basic psychological needs: a self-determination theory perspective on the promotion of wellness across development and cultures. In I. Gough &

J. A. McGregor (Eds.), *Wellbeing in Developing Countries: From Theory to Research* (pp. 71–92). chapter, Cambridge: Cambridge University Press.
Silva, A. G., Lã, F., & Afreixo, V. (2015). Pain prevalence in instrumental musicians: A systematic review. *Medical Problems of Performing Artists*, *30*(1), 8–19. DOI: https://doi.org/10.21091/mppa.2015.1002.
Stabell, E. (2018). Being talented—Becoming a musician: A qualitative study of learning cultures in three junior conservatoires. *Nordic Research in Music Education, 19*, 21–40.
Stanek, J. L., Komes, K. D., & Murdock, F. A. (2017). A cross-sectional study of pain among US college music students and faculty. *Medical Problems of Performing Artists*, *32*(1), 20–26. DOI: https://doi.org/10.21091/mppa.2017.1005
Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (Vol. 6). Pearson Education.
Unanue, W., Gómez, M. E., Cortez, D., Oyanedel, J. C., & Mendiburo-Seguel, A. (2017). Revisiting the link between job satisfaction and life satisfaction: The role of basic psychological needs. *Frontiers in Psychology*, *8*, 680. DOI: https://doi.org/10.3389/fpsyg.2017.00680.
Valenzuela, R., Codina, N., & Pestana, J. V. (2017). Self-determination theory applied to flow in conservatoire music practice: The roles of perceived autonomy and competence, and autonomous and controlled motivation. *Psychology of Music*, *46*(1), 33–48. DOI: https://doi.org/10.1177/0305735617694502.
Vallerand, R. J. (2015). *The psychology of passion: A dualistic model.* Oxford University Press. DOI: https://psycnet.apa.org/doi/10.1093/acprof:oso/9780199777600.001.0001
Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, *23*(3), 263–280. DOI: https://doi.org/10.1037/a0032359.
Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation and Emotion*, *44*(1), 1–31. DOI: https://doi.org/10.1007/s11031-019-09818-1.
Vaag, J., Bjørngaard, J. H., & Bjerkeset, O. (2016). Symptoms of anxiety and depression among Norwegian musicians compared to the general workforce. *Psychology of Music*, *44*(2), 234–248. DOI: https://doi.org/10.1177/0305735614564910.
Wei, M., Shaffer, P. A., Young, S. K., & Zakalik, R. A. (2005). Adult attachment, shame, depression, and loneliness: The mediation role of basic psychological needs satisfaction. *Journal of Counseling Psychology*, *52*(4), 591–601. DOI: https://doi.org/10.1037/0022-0167.52.4.591.
Williamon, A., & Thompson, S. (2006). Awareness and incidence of health problems among conservatoire students. *Psychology of Music*, *34*(4), 411–430. DOI: https://doi.org/10.1177/0305735606067150.
Williams, G. C., Halvari, H., Niemiec, C. P., Sørebø, Ø., Olafsen, A. H., & Westbye, C. (2014). Managerial support for basic psychological needs, somatic symptom burden, and work-related correlates: A self-determination theory perspective. *Work & Stress*, *28*(4), 404–419. DOI: https://doi.org/10.1080/02678373.2014.971920.
Wristen, B. G. (2013). Depression and anxiety in university music students. *Update: Applications of Research in Music Education*, *31*(2), 20–27. DOI: https://doi.org/10.1177/8755123312473613.

Wristen, B. W., & Fountain, S. E. (2013). Relationships between depression, anxiety, and pain in a group of university music students. *Medical Problems of Performing Artists, 28*(3), 152–158. DOI: https://doi.org/10.1016/S0277-9536(98)00307-4

Yoo, H. (2021). A motivational sequence model of high school ensemble students' intentions to continue participating in music. *Journal of Research in Music Education, 69*(2), 167–187. DOI: https://doi.org/10.1177/0022429420954880.

Zaza, C., Charles, C., & Muszynski, A. (1998). The meaning of playing-related musculoskeletal disorders to classical musicians. *Social Science & Medicine, 47*(12), 2013–2023. DOI: https://doi.org/10.1016/S0277-9536(98)00307-4.

Appendices

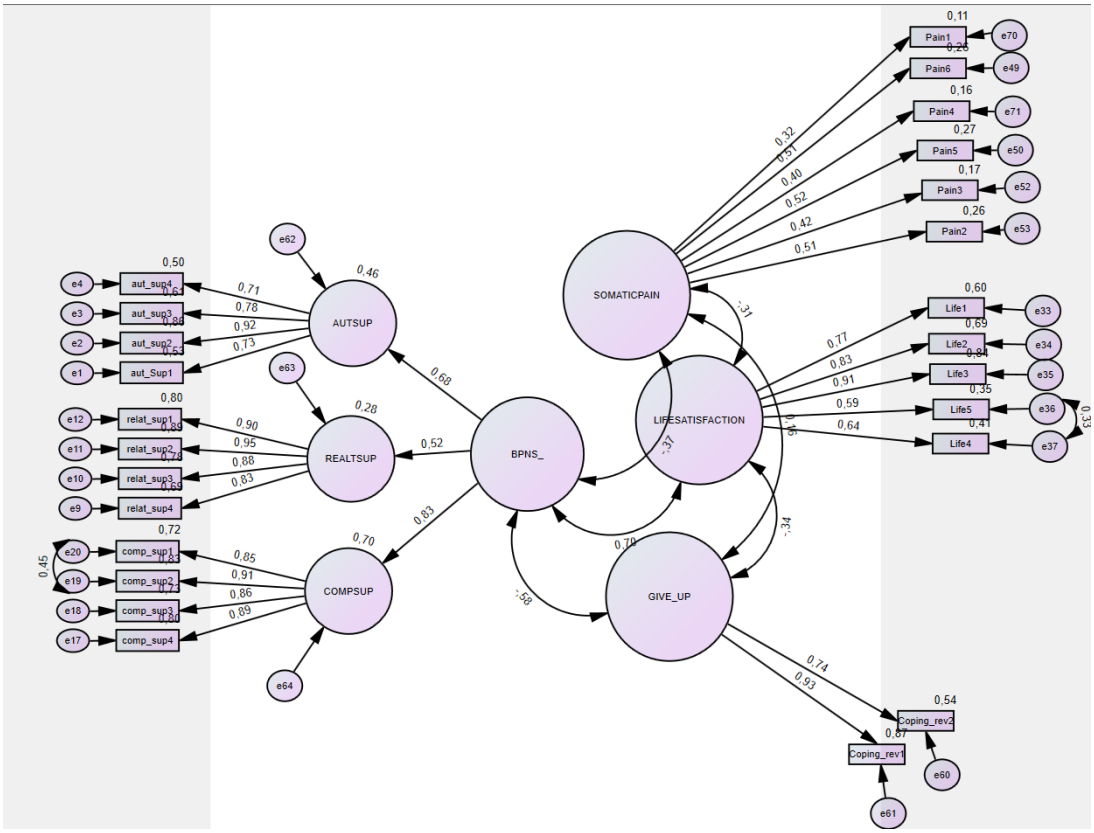
Appendix A. Descriptive Statistics for Study Variables

Variable and Item	***M***
The following questions are related to your life as an aspiring musician and music student:	
Autonomy Satisfaction	
1. I have a feeling of choice and freedom in what I do as a music student	5.00
2. I feel that the decisions I make as a music student reflect what I really want	4.78
3. As a music student, I feel that the choices I make express who I really am	4.75
4. As a music student, I feel that I do what really interests me	5.29
Autonomy Frustration	
1. Most of the things I do as a music student, I do because I feel that I have to	3.76
2. As a music student, I feel forced to do many things that I would not have chosen to do	3.50
3. I feel pressured to do many of the things I do as a music student	3.29
4. My daily activities as a music student feel like a continuous line of duties	3.60
Relatedness Satisfaction	
1. I feel that the people I care about at college also care about me	5.36
2. I feel connected to the people at college who care about me and whom I care about	5.31
3. I feel closely connected to other people who are important to me at college	5.00
4. I experience a warm and good feeling with the people I spend time with at college	5.43
Relatedness Frustration	
1. At college, I feel excluded from the group that I want to be a part of	2.41
2. At college, I feel that the people that are important to me are cold and distant towards me	1.78
3. I have the impression that people that I spend time with at college dislike me	1.94
4. I feel that the relations I have at college are only superficial	2.63
Competence Satisfaction	
1. I feel confident that I can do things well as a music student	4.91
2. I feel capable of doing what I do as a music student	4.99
3. I feel competent in reaching my goals as a music student	4.95
4. I feel that I can successfully complete difficult tasks as a music student	5.08
Competence Frustration	
1. I seriously doubt whether I can do things well as a music student	3.35
2. I feel disappointment at many of my achievements as a music student	3.29
3. I feel insecure about my abilities as a music student	4.07
4. As a music student, I feel like a failure because of the mistakes I make	3.13
During the past 4 weeks (when practicing and/or performing), how much have you been bothered by any of the following problems?	

Variable and Item	*M*
Somatic Symptom Burden	
1. Pain in your face, lips, or mouth	1.37
2. Back pain	1.82
3. Pain in your arms, shoulders, or joints (elbow, hips, fingers, etc.)	1.82
4. Pain caused by inflammation	1.29
5. Headaches	1.72
6. Trouble sleeping	1.80
Life Satisfaction	
1. In most ways my life is close to my ideal	3.98
2. The conditions of my life are excellent	4.35
3. I am satisfied with my life	4.63
4. If I could live my life over, I would change almost nothing	4.41
5. So far, I have gotten the important things I want in life	4.02
Giving Up	
1. I usually give up when I'm not achieving the desired performance results	2.41
2. I usually give up when I repeatedly fail to perform difficult passages while practicing	2.56

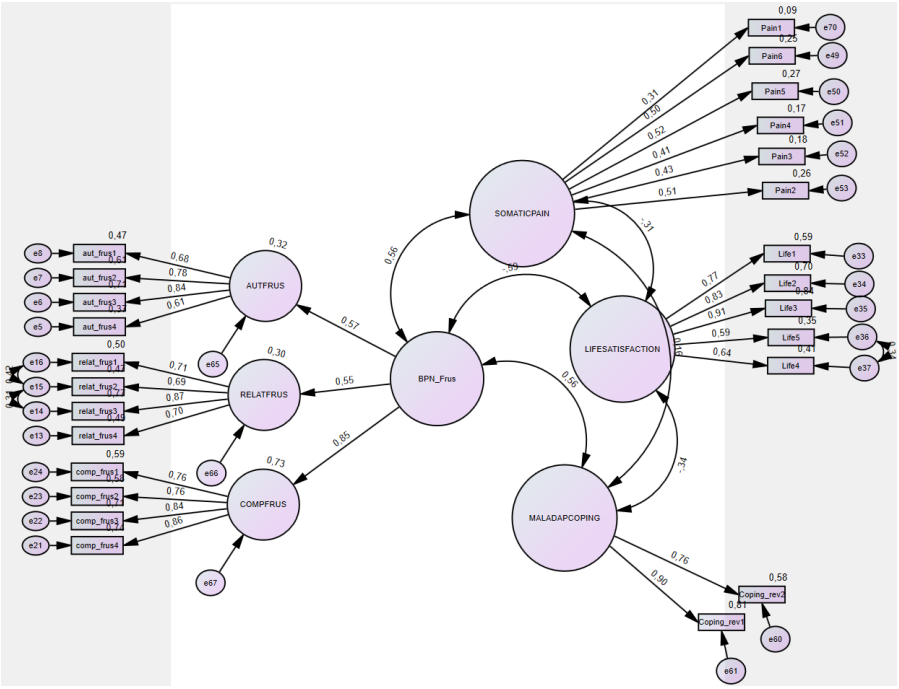
Note. Mean scores represent the average response for each item.

Appendix B1a. Second Order Four-Factor CFA of BPNS with Observed and Latent Variables



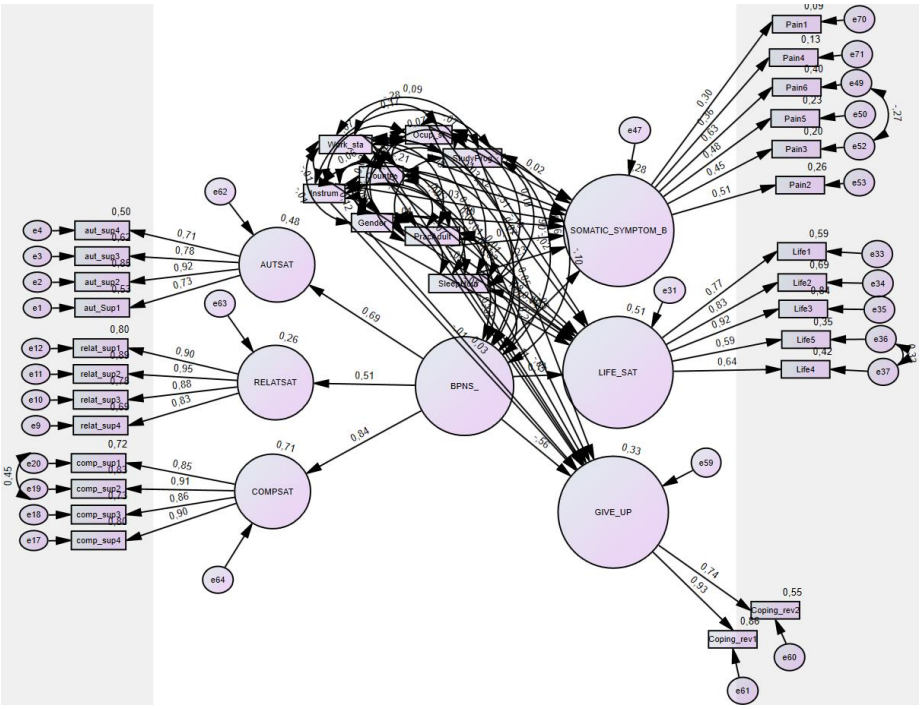
Note. In this study, error terms for specific indicators were allowed to covary to improve model fit and address potential measurement-related confounds. This decision was based on both theoretical and empirical considerations. Byrne (2016) emphasizes that items within the same construct or subscale often share content overlap, this is especially common in scales with many items. This overlap can result in correlated errors, which can be addressed by allowing the error terms to covary.

Appendix B1b. Second Order Four-Factor CFA of BPNF with Observed and Latent Variables.



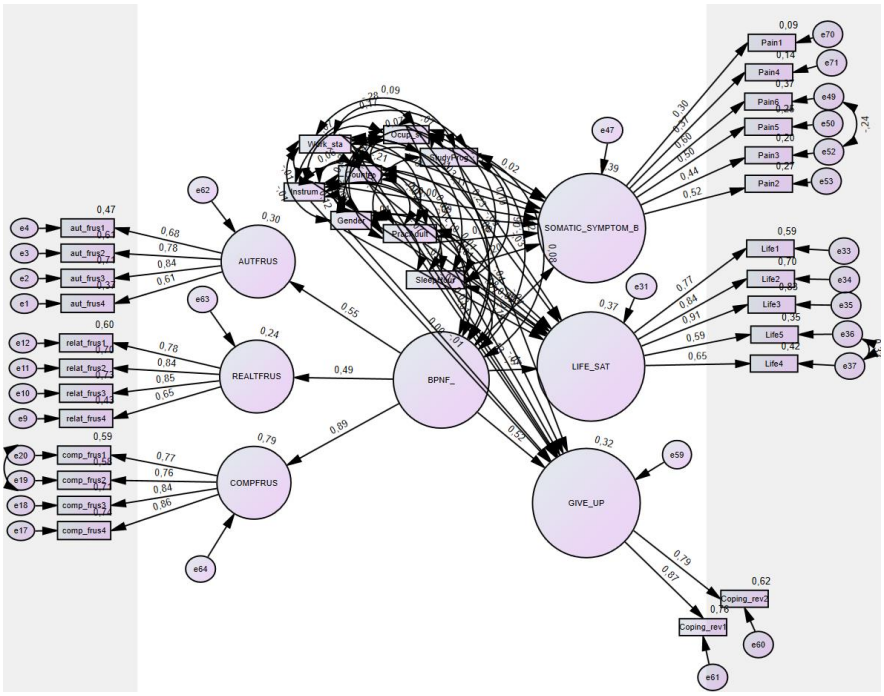
Note. In this study, error terms for specific indicators were allowed to covary to improve model fit and address potential measurement-related confounds. This decision was based on both theoretical and empirical considerations. Byrne (2016) emphasizes that items within the same construct or subscale often share content overlap, this is especially common in scales with many items. This overlap can result in correlated errors, which can be addressed by allowing the error terms to covary.

Appendix B2a. Latent and Observed Variables with Explained variance in SEM 1 (BPNS).



Note. In this study, error terms for specific indicators were allowed to covary to improve model fit and address potential measurement-related confounds. This decision was based on both theoretical and empirical considerations. Byrne (2016) emphasizes that items within the same construct or subscale often share content overlap, this is especially common in scales with many items. This overlap can result in correlated errors, which can be addressed by allowing the error terms to covary.

Appendix B2b. Latent and Observed Variables with Explained variance in SEM 1 (BPNF).



Note. In this study, error terms for specific indicators were allowed to covary to improve model fit and address potential measurement-related confounds. This decision was based on both theoretical and empirical considerations. Byrne (2016) emphasizes that items within the same construct or subscale often share content overlap, this is especially common in scales with many items. This overlap can result in correlated errors, which can be addressed by allowing the error terms to covary.