



The interplay between psychological need satisfaction and psychological need frustration within a work context: A variable and person-oriented approach

Peter C. Rouse¹ · Philip J. F. Turner^{1,2} · Andrew G. Siddall³ · Julia Schmid⁴ · Martyn Standage¹ · James L. J. Bilzon¹

© The Author(s) 2019

Abstract

A plethora of empirical data support a positive (or “brighter”) pathway to optimal human functioning as specified within Basic Psychological Needs Theory (Ryan and Deci in *Psychol Inq* 11(4):319–33, 2000). Yet, far less is known about the negative (or “darker”) pathway, a process evoking of human dysfunction and ill-being (cf. Vansteenkiste and Ryan in *J Psychother Integr* 23(3):263, 2013). Further, debate surrounds the independence and interplay between psychological need satisfaction and psychological need frustration and how these dynamic constructs are experienced within individuals. In this work, variable and person-oriented analyses were employed to: (i) investigate the relationships between the basic psychological needs and symptoms of stress, depression and anxiety as well as with life satisfaction; and (ii) identify different psychological need profiles and their relationship with psychological function. Participants ($N = 2236$; M Age = 42.16 years; $SD = 7.8$) were UK-based operational firefighters who completed an online survey. Results of regression analyses showed a moderating effect of psychological need satisfaction on the relationship between need frustration and negative psychological symptoms. Latent profile analyses revealed five distinct basic psychological need profiles that carry implications for human psychological functioning. Some support for an asymmetrical relationship between need satisfaction and need frustration emerged (Vansteenkiste and Ryan in *J Psychother Integr* 23(3):263, 2013), yet, examples of above average need satisfaction and frustration scores were also observed. Worker profiles where psychological need frustration prevailed over need satisfaction had the poorest psychological health.

Keywords Basic psychological need satisfaction and frustration · Wellbeing · Variable-oriented approach · Person-oriented approach · Fire and rescue service

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s11031-019-09816-3>) contains supplementary material, which is available to authorized users.

✉ James L. J. Bilzon
j.bilzon@bath.ac.uk

¹ Department for Health, University of Bath, Bath BA2 7AY, UK

² Lancashire Fire and Rescue Service, Lancashire, UK

³ Occupational Physiology Research Group, University of Chichester, Chichester, UK

⁴ Institute of Sport Science, University of Bern, Bern, Switzerland

Introduction

Psychological dysfunction is a leading cause of absence at work, with operational firefighters at particular risk, due to everyday stressors and unavoidable exposure to traumatic events (Haslam and Mallon 2003; Jahnke et al. 2016). Hence, and with a view to protecting the health and well-being of work forces, it is important to understand the mechanisms that underpin their psychological dysfunction and ill-being. Within Basic Psychological Needs Theory (BPNT; Deci and Ryan 2000; Ryan and Deci 2000, 2017), it is proposed that humans achieve growth, development, and optimal functioning via the satisfaction of three basic psychological needs for autonomy, competence, and relatedness. In contrast, human dysfunction and ill-being are hypothesized to manifest when these same needs are actively frustrated. A wealth of empirical evidence has supported the positive consequences of psychological need

satisfaction, yet there is a lack of data on need frustration, its interplay with psychological need satisfaction, and the consequences for psychological dysfunction (cf. Vansteenkiste and Ryan 2013). To address such gaps in the extant literature, we conducted an original study that combines variable and person-oriented analyses to extend our knowledge of BPNT.

Basic psychological needs theory

BPNT (Deci and Ryan 2000) provides a fundamental and unifying foundation within the broader meta-theory of Self-Determination Theory (SDT; Deci and Ryan 2000; Ryan and Deci 2017; Vansteenkiste and Ryan 2013). Within BPNT, three inherent and universal psychological needs for autonomy, competence, and relatedness are essential nutrients for the physical, psychological, and social health of humans (Deci and Ryan 2002). When these needs are satisfied, it is hypothesized within BPNT that an individual will experience a sense of ownership and volition over tasks, actions and behaviors (autonomy), feel effective and capable of achieving valued outcomes (competence), and experience a closeness and genuine connection with valued others (relatedness; Chen et al. 2015). This sense of psychological need satisfaction unifies the social environment with positive cognitive, behavioral, and affective outcomes (Standage et al. 2019).

In contrast to the adaptive consequences of psychological need satisfaction, BPNT similarly specifies a unification between social environments and negative outcomes including physical and psychological dysfunction. Here, BPNT specifies a “darker side” wherein the focus is on the active frustration of the three basic psychological needs (Ryan and Deci 2000; Haerens et al. 2015). Specifically, experiencing need thwarting social contexts, provide the basis for the three needs to be actively frustrated. To the extent that an individual feels controlled by externally enforced or self-imposed pressures, experiences feelings of failure about one’s efficacy and feels directly excluded by important others, psychological dysfunction and ill-being will ensue. Until recent advancements in measurement (e.g., Bartholomew et al. 2011a; Chen et al. 2015), low need satisfaction had been indicative of need frustration in empirical studies with negative correlations indicating that low levels of need satisfaction relate to high levels of negative well-being. Yet, a lack of operationalization of need frustration fails to shed light on the independent role of need satisfaction and need frustration (Bartholomew et al. 2011b).

Conceptual differentiation between need satisfaction and need frustration

It is the distinction between the brighter (need satisfaction) and darker (need frustration) pathways that is important

because each possesses different antecedents and outcomes (Haerens et al. 2015; Vansteenkiste and Ryan 2013). For example, an individual may not experience relatedness with colleagues at work and consequently experience less vitality. In contrast, one may feel actively rejected and excluded by work colleagues, in which case, it is hypothesized that symptoms of stress, depression, and anxiety may ensue. Consequently, within BPNT it is posited that psychological need satisfaction supports the brighter side of human functioning whilst psychological need frustration drives the darker side. That is, psychological need satisfaction will be a better predictor of positive psychological functioning (i.e., life satisfaction, subjective vitality, and positive affect) than psychological need frustration whilst psychological need frustration will be a better predictor of negative psychological functioning (i.e., stress, depression, and anxiety) than psychological need satisfaction. Further, psychological need satisfaction and frustration can interact within a specific context, making a unique and combined contribution towards human functioning.

The bright and dark pathways associated with need satisfaction and need frustration

A wealth of empirical research provides support for the bright pathway with positive relationships observed between psychological need satisfaction and an array of beneficial outcomes including enjoyment (Álvarez et al. 2009), life-satisfaction (Martela and Ryan 2016; Van den Broeck et al. 2010), subjective well-being (Gillet et al. 2015; Martela and Ryan 2016; Ryan et al. 2010), vitality (Bernard et al. 2014), mental health (González et al. 2014), work performance (Van den Broeck et al. 2010), and mindfulness (Olafsen 2017). Further, a recent meta-analytic review of 99 studies supports the positive relationship between need satisfaction and indicators of well-being within work contexts (Van den Broeck et al. 2016). Sheldon and Niemiec (2006) also proposed that balance between the satisfactions of the basic psychological needs may be important to psychological well-being. Participants with greater balance in their need satisfaction reported higher well-being than those who reported the same total score but with greater variability across the needs. Yet, subsequent research has sometimes failed to provide support for the balanced hypothesis. For example, in an occupational context, a balance of satisfaction among the needs did not explain any additional variance in intrinsic motivation, above and beyond the main effects of the satisfaction of autonomy, competence, and relatedness (Dysvik et al. 2013).

Despite vast research focusing on basic need satisfaction, far less work has identified the unique emotional and psychological consequences associated with experiences of need frustration (i.e., darker pathway), despite recent calls in

the literature for this void to be addressed (Van den Broeck et al. 2016). Recent work has provided some evidence for the dark pathway by documenting a positive relationship between psychological need frustration and negative implications for human functioning such as depressive symptoms (Bartholomew et al. 2011a), negative affect (Gunnell et al. 2013), and emotional and physical exhaustion (Bartholomew et al. 2011b). Indeed, need frustration has been identified as a transdiagnostic process that underpins different types of psychopathologies (Campbell et al. 2018).

While far less research has been conducted in an occupational context (Van den Broeck et al. 2016), initial evidence indicates that psychological need frustration positively predicts work-related stress (Olafsen 2017), distress (Trépanier et al. 2015), and turnover intention (Gillet et al. 2015). Yet, it is the unique contribution that need frustration makes above and beyond psychological need satisfaction that yields evidence of the interplay between these pathways. Researchers have recently started to investigate the influence of both psychological need satisfaction and psychological need frustration on human functioning and the consequences of their interactions.

In an occupational setting, Gillet et al. (2012) tested a model that examined the influence of both psychological need satisfaction and psychological need frustration on indicators of well-being. Results revealed that need frustration experienced within the work environment significantly and negatively predicted eudaimonic and hedonic wellbeing. However, this study did not test the influence of need satisfaction and frustration on an indicator of ill-being, therefore, failing to test the contribution of need frustrations on psychological dysfunction. In contrast, Chen et al. (2015) investigated the predictive utility of composite scores of need satisfaction and need frustration on indicators of both positive and negative indicators of well-being. Results supported the unique role that need frustration plays in predicting depressive symptoms above and beyond that of need satisfaction. Subsequent analyses using separate autonomy, competence, and relatedness frustration scores showed all three needs to positively predict depressive symptoms. Collectively, these findings provide initial insight into the role of the darker pathway, yet the analyses did not tease out the individual contribution of need frustrations above and beyond the contributions of need satisfaction.

The interplay between psychological need satisfaction and psychological need frustration

Evidence is building to support the propositions of BPNT and the implications of the darker and brighter pathways for human functioning, yet little is known about the interplay between need satisfaction and need frustration. That is, what are the relationships between psychological need

satisfaction and frustration and how do they combine to influence outcomes of human functioning? Within BPNT, it is posited that an asymmetrical relationship exists between psychological need satisfaction and frustration, whereby low need satisfaction does not necessitate the existence of need frustration, but high need frustration does imply low need satisfaction (Vansteenkiste and Ryan 2013). However, little empirical research has tested this proposition.

Bartholomew et al. (2011b) tested the interactions between psychological need satisfaction and psychological need frustration within the same need and found three of the six interactions to be significant. The authors concluded that buffering effects can occur within sport settings whereby psychological need satisfaction attenuates the negative effect of psychological need frustration on vitality and exhaustion. Vansteenkiste et al. (2006) reported the interaction between different psychological needs to explain additional variance in Chinese students' adjustment to a new environment. Here we focus on the interaction within the same need to minimize the risk of inflated Type-1 error associated with multiple tests. Further, whilst this variable-oriented research offers important insight into the unique contribution of need satisfaction and frustration in predicting psychological well-being, this methodology does not allow an examination of the interplay between psychological need satisfaction and psychological need frustration.

A person-centred approach is better suited to the examination of theoretical frameworks that include interactionistic and dynamic conceptualizations (Bergman and Andersson 2010), especially when interactions exist at a within-person as well as between-person level (Lindwall et al. 2016). Person-oriented research offers an alternative angle by placing emphasis on describing differences among individuals and identifying groups of individuals who share similar patterns within target variables (Laursen and Hoff 2006). Previous person-oriented research grounded within SDT has identified motivation regulation profiles that relate differently to a variety of health, well-being and performance outcomes (Gustafsson et al. 2018; Howard et al. 2016; Lindwall et al. 2016, 2017; Van den Broeck et al. 2013). Such research highlights the complex interplay between motivational regulations and indicate that distinct profiles exist where individuals experience multiple motivations or goals (Lindwall et al. 2016; Standage and Ryan 2012). Despite the proposition that the basic psychological needs are as complex and dynamic in nature (Deci and Ryan 2000), the literature is remiss of person-oriented examinations of BPNT. Person-oriented research addressing basic psychological need profiles would test whether need satisfaction and need frustration operate in an asymmetrical way. That is, in profiles where need satisfaction is high, need frustration should be low but for profiles where need frustration is high, need satisfaction can be either high or low. These

basic psychological need profiles would also offer employers greater insight into their work forces need based functioning providing an opportunity to effectively alter the working environment to support improvements to the psychological well-being of their employees. Indeed, the person-oriented approach provides a holistic view of how psychological need satisfaction and frustration can simultaneously interact to predict employee ill-being, well-being, and job-related functioning.

The present study

Operational firefighters provide an ideal population within which to test the propositions of BPNT. Stress, depression, and anxiety are leading causes of absences at work and operational firefighters are at particular risk as they are exposed to everyday stressors as well as extreme stressors associated with attendance to emergency incidents and traumatic events (Harvey et al. 2016; Murphy et al. 1995; Murphy et al. 1999). The unavoidable exposure to these stressors emphasizes the importance of understanding how to protect firefighters against psychological dysfunction. Therefore, the fire service provides a context whereby psychological need dynamics could make a critical contribution to their psychological functioning. To date, no studies have systematically investigated BPNT, but previous work does show SDT to provide a relevant framework to test the mechanisms that relate to symptoms of stress, depression, anxiety and satisfaction with life in work contexts (Fernet 2013; Martela and Ryan 2016; Trépanier et al. 2015; Van den Broeck et al. 2010).

Initially, this study presents data on the validity of adapting the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al. 2015) for use in a work context. Schultz et al. (2015) adapted this scale for a work context and showed the internal reliability of the scores to be good ($\alpha = .88-.90$), yet evidence of the factor structure was not provided. Subsequently, this study combines variable-oriented and person-oriented analyses to yield unique and complementary information on the interplay between need satisfaction and need frustration. Specifically, variable-oriented analyses extend the literature by testing the moderating effect of psychological need satisfaction on the “darker side”. We hypothesized, that psychological need frustration will explain additional variance in the prediction of each outcome, with the frustration of the needs showing stronger predictive utility compared to need satisfaction with each of the negative outcomes (HO1). Further, the inclusion of the interaction terms between need satisfaction and frustration will test the moderating effect of psychological need satisfaction on the theorized positive relationship between psychological need frustration and psychological functioning. Based on the propositions

within BPNT and previous research (Bartholomew et al. 2011a, b; Vansteenkiste et al. 2006), we hypothesized that the corresponding need satisfaction and frustration subscales will interact to explain additional variance in stress, depression, anxiety, and satisfaction with life (HO2).

Person-oriented analyses were used to offer a unique and complementary insight into the interplay within and between psychological need satisfaction and need frustration (i.e., individual profiles), and examine the relationship of different profiles with indices of human psychological dysfunction. Therefore, the person-oriented analyses is needed to, (i) test the proposition that the interplay between need satisfaction and need frustration indicates an asymmetrical relationship (ii) identify the relationships between different psychological need profiles and indices of well-being, (iii) test whether balance is experienced in the basic psychological needs, and (iv) provide employers with knowledge of their workforces need-based functioning.

Due to a lack of research testing tenets within BPNT using person-oriented analyses, no a priori hypotheses were advanced. Yet, based on theoretical propositions, we would expect that (i) where need satisfaction profiles prevail over need frustration, fewer symptoms of stress, depression, and anxiety might be expected; (ii) the reverse relationship to exist when the need frustration profile prevails over need satisfaction. It is less clear what relationships exist with the maladaptive outcomes when profiles of need satisfaction and frustration are similar.

Methods

Participants

Participants were 2236 operational firefighters working in the UK and on average were 42.16 ($SD = 7.8$) years old, predominantly male (91%), white British (88%), and had a mean Body Mass Index (BMI) of 26.7 kg/m^2 ($SD = 3.32$). Participants self-reported participating in 303 ($SD = 329$) minutes of vigorous physical activity a week, 324 ($SD = 497$) minutes of moderate physical activity a week, and 250 ($SD = 217$) minutes per week in sedentary time. The sample consisted of operational firefighters who self-selected to complete an online questionnaire. The link to the survey was opened 3063 times indicating a 73% response rate. Although not included here, the survey also gathered self-reported data on nutrition and sleep behavior (see Turner et al. 2018). Ethical approval for the study was obtained from the University of Bath’s Research Ethics Approval Committee for Health (Reference Number: EP 12/13 6).

Measures

Need satisfaction and frustration

Participants completed the Psychological Need Satisfaction and Frustration Scale (Chen et al. 2015), with the stem targeted to the work context. Specifically, firefighters were requested to rate their personal experience at work for the fire service with four items measuring each of the six subscales, rated on a 5-point Likert scale ranging from 1 “completely untrue” to 5 “completely true”. Good levels of reliability were obtained for autonomy satisfaction ($\alpha = .88$; I feel that my decision reflect what I really want”), competence satisfaction ($\alpha = .92$; I feel capable at what I do”), and relatedness satisfaction ($\alpha = .92$; I feel that the people I care about me”). Similar levels of reliability were obtained for autonomy frustration ($\alpha = .87$; I feel pressured to do many things), competence frustration ($\alpha = .87$; I feel insecure about my abilities), and relatedness frustration ($\alpha = .89$; I feel excluded from the group I want to belong to). Initial validation of the 6-factor scale, factorial validity, and aspects of construct validity related to scores from the measure has been supported across four countries (Chen et al. 2015).

Depression, anxiety and stress

Participants completed the Depression, Anxiety, and Stress Scales (DASS-21; Lovibond and Lovibond 1995) to capture the three negative pathologies. The DASS-21 instrument contains 7-items per subscale, each demonstrating good levels of reliability. Example items for each subscale include “I felt that life was meaningless” (depression; $\alpha = .92$), “I found it hard to wind down” (Stress; $\alpha = .90$) and “I felt I was close to panic” (anxiety; $\alpha = .80$). All items were rated on a 4-point scale ranging from 0 “Did not apply to me at all” to 3 “Applied to me very much or most of the time”. Scores from 7 items are summed to produce a total score for each subscale (max = 21). The DASS-21 has demonstrated good levels of structural construct validity in a UK adult population (Henry and Crawford 2005).

Life satisfaction

As a measure of positive psychological wellbeing, participants completed the 5 item Satisfaction with Life Scale (Diener et al. 1985) to contrast the predictive roles of need satisfaction and need frustration. Items (e.g., I am satisfied with my life) were rated on a 7 point scale ranging from 1 “strongly disagree” to 7 “strongly agree”. The scale has been widely used and demonstrated good levels of reliability and convergent validity (Pavot and Diener 2009).

Data analyses

Variable-oriented analyses

To detect multivariate outliers, we calculated the Mahalanobis distance values as χ^2 at $p < .001$ (Tabachnik and Fidell 2013) and excluded 15 multivariate outliers (0.67%) from the sample. Following data screening, descriptive statistics, and bivariate correlations were computed. Subsequently, and due to its recent development, the factor structure of the Basic Psychological Need Satisfaction and Frustration Scale was tested via confirmatory factor analyses (CFA) using AMOS (Version 22.0; Arbuckle 2013). Model fit was examined using a variety of fit indexes including: CMIN/DF which accounts for sample size, comparative fit index (CFI) and the root mean square error of approximation (RMSEA) (with 90% confidence intervals). A model is deemed to demonstrate a good fit to the data if the CMIN/DF does not exceed 3, CFI is equal to or less than .95 and the RMSEA are equal to or less than .08 and .06 respectively (Browne and Cudeck 1993; Byrne 2006; Hu and Bentler 1999). Once the structural aspect of construct validity had been established assumptions of collinearity and multivariate outliers were assessed. A dependent *t* test examined the difference in mean scores between the satisfaction and frustration of each basic psychological need. Cohen’s *d* was calculated as an effect size where 0.2 is considered small, 0.5 medium and above 0.8 large (Cohen 1988).

Previous research (Chen et al. 2015) has revealed significant correlations between the basic psychological needs raising concerns over multi-collinearity. Therefore, standardized residuals were examined for homoscedasticity (i.e., to ensure a normal distribution and identify any influential cases). Further, correlation coefficients and the variation inflation factor (VIF) were examined to check the assumption of multicollinearity. Multicollinearity occurs when two or more variables correlate too highly ($> .80$) in a regression model and therefore it is difficult to establish each predictor’s unique contribution to the outcome. The VIF is a collinearity diagnostic to identify whether two predictors share too strong a relationship. VIF scores of 10 provide cause for concern, however, mean scores higher than 1 indicates that multicollinearity could influence the regression model. Lastly, a tolerance statistic lower than .02 also suggests a violation of the assumption of multicollinearity (Tabachnick and Fidell 2007).

Finally, in order to establish the unique contribution that need frustration made above and beyond that of psychological need satisfaction, four separate hierarchical regression analyses were conducted in SPSS (Version 22.0) for stress, depression, anxiety, and life satisfaction. As recommended by Aiken and West (1991), all scores were centered prior to being entered into the regression analyses. In Step 1,

satisfaction of the psychological needs for autonomy, competence, and relatedness were entered. In Step 2, frustration of the psychological needs for autonomy, competence, and relatedness were entered. Finally, in Step 3 the interaction terms between each of the corresponding psychological need satisfactions and frustrations were entered (e.g., autonomy satisfaction x autonomy frustration). Interaction plots were used to examine their impact on the outcomes.

Person-oriented analyses

To identify profiles of psychological need satisfaction and frustration that existed within operational firefighters, we conducted latent profile analysis (LPA; Masyn 2013). Statistical as well as content-related indicators were combined to determine the optimal number of profiles. We employed the Bayesian Information Criterion (BIC), the entropy, the Lo-Mendell-Rubin adjusted likelihood ratio test (LRMT), and the Bootstrapped likelihood-ratio test (BLRT) as statistical indicators. With larger sample sizes, Morin and Wang (2016) recommend also applying the “elbow-criterion” by graphical plots of the BIC. According to this criterion, a profile solution is chosen, after the slope flattens out. As content-related indicators, we used the principle of parsimony, theoretical consideration, interpretability, and the replicability of the profile solutions. For the latter, we randomly split the sample in two (Haahr 2018) to conduct separate LPA with the two subsamples, to examine whether similar profiles emerged. To support interpretation of the profiles, z-scores of the six need indicators were calculated. There are no clear criteria within the extant literature regarding what constitutes high and low values, therefore, we followed an approach adopted by previous research (Gustafsson et al. 2018) when interpreting the nature of the profiles. Specifically, values of ± 1 SD were classified as very high/low, ± 0.5 to 1 SD as high/low, and -0.5 to 0.5 SD as slightly above/below average. To examine how the latent profiles differ in terms of psychological health, anxiety, stress, depression and life satisfaction were included as outcome variables (so-called auxiliary variables; see Muthén and Asparouhov 2014). We conducted overall Wald’s tests and pairwise profile comparisons between the probabilities for classes and the auxiliary variable means. Effect sizes (Hedges *g*) were calculated, dividing the difference in means by the pooled standard deviation of the relevant outcome variables. As with Cohen’s *d*, the values for Hedges *g* effect size values are interpreted as 0.2 (small), 0.5 (medium), and above 0.8 (large) (Cohen 1988).

All models were estimated in Mplus Version 8.0 (Muthén and Muthén 1998–2017) using maximum likelihood estimation with robust standard errors (MLR). Missing data (1.0% missing data) were accommodated via full-information maximum likelihood (FIML).

Univariate outlier analyses were conducted using z-scores and a cut-off of 3.29 and multivariate outlier analysis using Mahalanobis distance with the *p*-value of .001 (Tabachnik and Fidell 2007). We set the significance level for testing mean differences in psychological health at $p = .01$.

Results

Preliminary analyses

Measurement model

Results of a CFA showed the 6-factor basic psychological need satisfaction and need frustration scales to show good fit to the data: $\chi^2(237) = 2000.56$; CFI = .97; RMSEA = .03 (.03–.04) although an elevated CMIN/DF = 8.44 was observed. Factor loadings for all items were $> .70$, with the exception of item 5 which was .65 (autonomy frustration; “Most of the things I do, I feel like I have to”). A 3-factor solution for the three needs was also tested and found to demonstrate poor fit to the data ($\chi^2(249) = 15127.85$; CMIN/DF = 60.75; CFI = .73; RMSEA = .10 (.09–.10)).

Descriptive statistics

As shown in Table 1, mean scores show that on average operational firefighters experienced slightly higher levels of autonomy satisfaction to autonomy frustration ($t(2235) = 10.92$, $p \leq .001$) with a small effect size ($d = .23$). Perceptions of competence satisfaction were greater than competence frustration ($t(2235) = 80.46$, $p \leq .001$, $d = 1.25$) and perceptions of relatedness satisfaction were greater than perceptions of frustration ($t(2235) = 58.99$, $p \leq .001$, $d = 1.70$) with large effects. Participants scored highest in symptoms of stress ($M = 4.12$) followed by depression ($M = 3.38$) and anxiety ($M = 1.78$) indicating low levels of these negative pathologies. The mean score for life satisfaction ($M = 18.56$) was slightly lower than average according to established criteria (≤ 19 ; Pavot and Diener 2008).

The bivariate correlations between satisfaction of the basic psychological needs and frustration of the basic psychological needs were negative and small to moderate ($r = -.32$ to $-.53$), providing support for the discrimination between satisfaction and frustration of the basic psychological needs (Table 1). Need satisfaction subscales were moderately and negatively correlated with symptoms of stress, depression, and anxiety and positively correlated with life satisfaction. Need frustration demonstrated similar, but reverse relationships with these dependent variables.

Table 1 Descriptive statistics, Cronbach alphas and bivariate correlations for all variables

	α	Mean (SD)	1	2	3	4	5	6	7	8	9
1. Autonomy satisfaction	.88	3.25 (.89)									
2. Competence satisfaction	.92	4.13 (.72)	.34*								
3. Relatedness satisfaction	.92	3.73 (.86)	.39*	.28*							
4. Autonomy frustration	.87	2.88 (.96)	-.53*	-.20*	-.28*						
5. Competence frustration	.87	1.79 (.84)	-.32*	-.57*	-.31*	.29*					
6. Relatedness frustration	.89	1.82 (.88)	-.37*	-.29*	-.52*	.41*	.48*				
7. Stress	.92	4.12 (4.18)	-.35*	-.26*	-.28*	.43*	.40*	.42*			
8. Depression	.90	3.38 (4.29)	-.49*	-.31*	-.36*	.47*	.43*	.46*	.77*		
9. Anxiety	.80	1.78 (2.59)	-.29*	-.29*	-.23*	.31*	.41*	.35*	.73*	.66*	
10. Life satisfaction	.91	18.56 (7.14)	.44*	.30*	.38*	-.38*	-.36*	-.37*	-.40*	-.52*	-.34*

* $p < .01$

Primary analyses

Hierarchical regression analyses

Assumptions of collinearity were tested for each regression. Results showed no violations (VIF's $< .18$ and tolerances = .56–.92). Gender and age were included as control variables but were non-significant.

In Step 1 (See Table 2), satisfaction of the three basic psychological needs were included and showed a significant overall model ($p < .01$) explaining variance in symptoms of stress (16%), depression (28%), anxiety (13%), and life satisfaction (26%). Individual beta values showed all three psychological needs to significantly predict all four outcomes.

Adding need frustration in Step 2 improved the model fit and explained additional variance in symptoms of stress, depression, anxiety, and life satisfaction. Frustration of the three psychological needs all made significant positive and unique contributions to the prediction of symptoms of stress, depression, and anxiety. Only autonomy and competence frustration significantly and negatively predicted life satisfaction. Autonomy frustration had the strongest relationship with stress, whereas competence frustration showed the strongest relationship with anxiety. Both autonomy and competence frustration positively predicted depressive symptoms and negatively predicted life satisfaction. The addition of psychological need frustration compressed the relationships between psychological need satisfaction and the outcomes although autonomy satisfaction remained significantly and negatively associated with each. Autonomy satisfaction also had the strongest negative relationship with depressive symptoms.

Adding the interaction terms between the corresponding psychological need satisfaction and psychological need frustration scales explained further and a significant amount of variance for symptoms of stress, depression and anxiety but not life satisfaction. All three interactions demonstrated

significant and negative relationships with symptoms of depression and anxiety whilst only the autonomy interaction had a significant relationship with stress. Plotting the interaction terms reveals that being high in psychological need satisfaction moderates the positive relationship that psychological need frustration has with symptoms of stress, depression, and anxiety (see Fig. 1 for example). At both high and low levels of need satisfaction, increased levels of need frustration were associated with more symptoms of stress, depression, and anxiety ($p < .001$) except for one. At high levels of autonomy satisfaction, the relationship between autonomy frustration and anxiety was non-significant ($b = .09$; $p = .23$) but at low levels of autonomy satisfaction, increased levels of autonomy frustration were significantly related to increased symptoms of anxiety ($b = .57$; $p < .001$). Across all needs, symptoms of stress, depression, and anxiety were highest when firefighters experienced low levels of need satisfaction and high levels of need frustration. The significance of the slopes at 1 SD above and below the mean of need satisfaction (moderator) are provided in Table 3.

Person-oriented analyses

Psychological need satisfaction and frustration profiles

Univariate and multivariate outlier analyses indicated that 41 and 10 cases should be removed ($N = 2185$). Entropy, LRMT and BLRT indicated that all solutions up to 7 fitted the data well (see Supplement 1). The BIC decreased for each model. More precisely, the elbow plot (see Supplement 2) showed that the improvement in fit reaches a first plateau at 2 and 5 profiles, and again at 6 profiles. These three solutions were then closely inspected to examine their theoretical meaningfulness, interpretability, and replicability. In order to further verify and differentiate the number of profile solutions, we examined the stability of profile solutions.

Table 2 Hierarchical regression analyses with the basic psychological needs predicting stress, depression, anxiety and life satisfaction

	Stress			Depression			Anxiety			Life satisfaction		
	F Change	R ²	β	F Change	R ²	β	F Change	R ²	β	F Change	R ²	β
Step 1 ^a	139.40*	.16		285.60*	.28		113.26*	.13		264.81*	.26	
Autonomy satisfaction			-.25*			-.38*			-.18*			.31*
Competence satisfaction			-.13*			-.13*			-.20*			.13*
Relatedness satisfaction			-.14*			-.17*			-.11*			.22*
Step 2 ^a	144.05*	.30		125.76*	.39		88.95*	.23		41.15*	.30	
Autonomy satisfaction			-.07*			-.23*			-.07*			.22*
Competence satisfaction			-.01			-.02			-.06*			.05
Relatedness satisfaction			-.02			-.06*			.01			.17*
Autonomy frustration			.26*			.20*			.13*			-.14*
Competence frustration			.20*			.20*			.25*			-.14*
Relatedness frustration			.18*			.16*			.13*			-.06
Step 3 ^a	10.79*	.31		12.46*	.41		24.77*	.26		1.53	.30	
Autonomy satisfaction			-.06*			-.21*			-.05*			.22*
Competence satisfaction			-.02			-.01			-.06*			.05
Relatedness satisfaction			-.03			-.06*			-.01			.18*
Autonomy frustration			.25*			.20*			.13*			-.14*
Competence frustration			.19*			.17*			.22*			-.13*
Relatedness frustration			.16*			.13*			.11*			-.07*
Autonomy interaction satisfaction × frustration			-.09*			-.11*			-.11*			.02
Competence interaction satisfaction × frustration			-.03			-.08*			-.10*			.02
Relatedness interaction satisfaction × frustration			-.02			-.06*			-.05*			-.04

β standardised beta weight

*p < .01

^aControl variables included age and gender

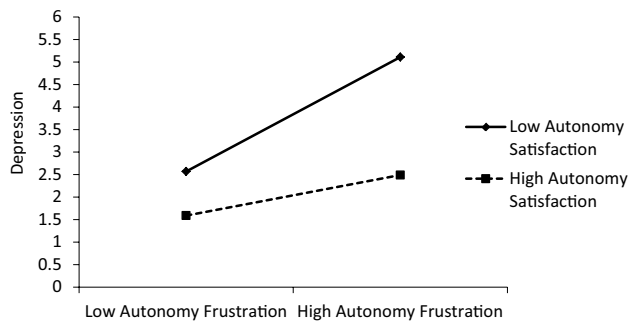


Fig. 1 Example significant interaction between need satisfaction and frustration on indicators of depression

To achieve this, we randomly split the sample in two, conducted separate LPA with the two subsamples, and examined whether similar profiles emerged. A comparison of the two solutions provided support for the 5-factor solution. Given that this solution was interpreted as theoretically meaningful and demonstrated parsimony, we favored and moved forward with the 5-profile model (see Table 4 for mean and z scores). Interpretation of the different profiles reveals that the profiles become progressively less adaptive. Profile 1 can be described as “High Satisfaction, Low Frustration” with higher satisfaction than frustration scores across the three needs. In contrast, Profile 5 can be seen as a “Low Satisfaction, Very High Frustration” profile with frustration scores higher than satisfaction across the three needs. Profile 3 is “Very High Competence Satisfaction, High Frustration” profile with the least discrepancy between overall need satisfaction and frustration. Profile 2 “Slightly Above Average Satisfaction, Slightly Below Average Frustration” has a reduced level of need satisfaction and slightly higher frustration scores. Profile 3 “Very High Competence Satisfaction, High Frustration” introduces more need frustration whilst maintaining high competence satisfaction. Finally, Profile 4 “Slightly Below Average Satisfaction, High Frustration” is a moderate version of the least adaptive Profile 5. Examination of Table 3 indicates that most profiles demonstrate

contrasting levels of need satisfaction and frustration for each psychological need. Although Profiles 2 and 5 have above average scores for both relatedness satisfaction and relatedness frustration and Profile 1 had similar levels of competence satisfaction and competence frustration.

Symptoms of psychological dysfunction by profile

Latent profile differences in symptoms of stress, depression, anxiety, and life satisfaction are shown in Table 4. The overall test of equality of means were significant for anxiety ($\chi^2(4) = 231.508, p < .0005$), stress ($\chi^2(4) = 364.697, p < .0005$), depression ($\chi^2(4) = 473.211, p < .0005$), and life satisfaction ($\chi^2(4) = 446.299, p < .0005$). Pairwise comparisons revealed that Profiles 1 and 2 were the most adaptive profiles, with firefighters experiencing the fewest symptoms of stress, depression and anxiety as well as the highest levels of life satisfaction. The majority of operational firefighters (65%) exhibited these two most adaptive profiles where need satisfaction mostly prevailed over need frustration. In contrast, Profiles 4 and 5 experienced the worst levels of psychological dysfunction. Pairwise comparisons between Profile 1 and Profile 2 showed no significant difference in mean scores for stress ($g = .08$) and anxiety ($g = .07$). Similarly, no significant differences were observed between Profile 3 and Profile 4 for anxiety ($g = .16$), depressive symptoms ($g = .09$) or stress ($g = -.25$). Finally, no significant difference in stress was observed between Profile 4 and Profile 5 ($g = .27$) (see Supplement 3 for all effect sizes).

Discussion

In one of the largest samples to examine propositions within BPNT, this study employs both variable and person-oriented analyses to investigate the interplay between the satisfaction and frustration of the basic psychological needs and the relationship with human psychological dysfunction. Combining these two approaches has extended the literature by

Table 3 Simple slopes at high (+ 1SD) and low (+ 1SD) levels of need satisfaction on the effect of the relationship between need frustration and indicators of stress, depression and anxiety

	Stress			Depression			Anxiety		
	B	T	p	B	t	p	B	t	p
Autonomy satisfaction									
High (+ 1SD)	.75	6.42	<.001	.47	4.22	<.001	.09	1.20	.23
Low (- 1SD)	1.38	12.36	<.001	1.25	11.93	<.001	.57	7.89	<.001
Competence satisfaction									
High (+ 1SD)	.74	5.97	<.001	.57	4.87	<.001	.45	5.68	<.001
Low (- 1SD)	.87	8.68	<.001	.90	9.46	<.001	.70	10.87	<.001
Relatedness satisfaction									
High (+ 1SD)	.61	4.74	<.001	.41	3.31	.001	.19	2.27	.02
Low (- 1SD)	.74	7.08	<.001	.73	7.35	<.001	.35	5.24	<.001

Table 4 Mean (SD) and Z standardized scores for need satisfaction/frustration and psychological outcomes of the 5 latent profiles

Profile variables	Profile 1 ^a <i>n</i> = 570 (26%) High satisfaction, low frustration		Profile 2 ^b <i>n</i> = 854 (39%) Slightly above average satisfaction, slightly below frustration		Profile 3 ^c <i>n</i> = 134 (6%) Very high competence satisfaction, high frustration		Profile 4 ^d <i>n</i> = 444 (20%) Slightly below average satisfaction, high frustration		Profile 5 ^e <i>n</i> = 183 (9%) Low satisfaction, very high frustration	
	<i>M</i> (<i>SD</i>)	<i>Z</i>	<i>M</i> (<i>SD</i>)	<i>Z</i>	<i>M</i> (<i>SD</i>)	<i>Z</i>	<i>M</i> (<i>SD</i>)	<i>Z</i>	<i>M</i> (<i>SD</i>)	<i>Z</i>
Overall need satisfaction	4.01 (.56)	0.73	3.81 (.56)	0.47	3.63 (.56)	0.24	3.30 (.56)	-0.18	2.76 (.56)	-0.87
Autonomy satisfaction	3.78 (.76)	0.59	3.42 (.76)	0.16	2.95 (.76)	-0.37	2.76 (.76)	-0.59	2.52 (.76)	-0.87
Relatedness satisfaction	4.23 (.69)	1.63	3.97 (.69)	1.31	3.07 (.69)	0.23	3.23 (.69)	0.43	3.01 (.69)	0.16
Competence satisfaction	4.90 (.22)	1.14	4.03 (.22)	-0.23	4.88 (.22)	1.11	3.91 (.22)	-0.42	2.74 (.22)	-2.23
Overall need frustration	1.63 (.66)	-0.60	1.88 (.66)	-0.31	2.66 (.66)	0.59	2.82 (.66)	0.77	3.02 (.66)	1.07
Autonomy frustration	2.41 (.85)	-0.49	2.67 (.85)	-0.21	3.60 (.85)	0.76	3.45 (.85)	0.60	3.33 (.85)	0.48
Relatedness frustration	1.24 (.53)	-0.66	1.35 (.53)	-0.52	2.95 (.53)	1.35	2.64 (.53)	0.99	2.68 (.53)	1.04
Competence frustration	1.23 (.59)	-0.68	1.61 (.59)	-0.21	1.43 (.59)	-0.42	2.36 (.59)	0.73	3.06 (.59)	1.60
Outcomes										
Anxiety	0.91 (1.67) ^{cde}		1.09 (1.75) ^{cde}		2.26 (3.13) ^{abce}		2.68 (3.16) ^{abce}		4.59 (4.60) ^{abced}	
Stress	2.49 (3.10) ^{cde}		2.81 (3.51) ^{cde}		5.51 (5.33) ^{abce}		6.55 (4.85) ^{ab}		7.65 (5.95) ^{abce}	
Depression	1.46 (2.86) ^{bcd}		1.88 (3.21) ^{acde}		5.43 (5.56) ^{abce}		5.82 (5.06) ^{abce}		7.83 (5.82) ^{abced}	
Satisfaction with life	21.93 (6.44) ^{bcd}		20.33 (6.43) ^{acde}		16.81 (7.53) ^{abde}		14.44 (8.01) ^{abcde}		12.50 (7.58) ^{abced}	

^{abcde}Indicate significant difference in outcomes between profiles (*p* < .01)

identifying that psychological need satisfaction can moderate the effect of the darker pathway, attenuating the positive relationship between psychological need frustration and psychological dysfunction. In addition, our large sample size allowed the inclusion of all six psychological need satisfaction and need frustration variables in the same statistical model, thus allowing us to identify the unique predictive utility of each towards psychological dysfunction. Prior to this special issue, person-oriented analyses had not been utilized in the published peer-reviewed literature to examine the existence of need satisfaction and need frustration profiles. Different profiles of basic psychological needs were identified that provide some support for the previously theorized asymmetrical relationship between need satisfaction and need frustration (Vansteenkiste and Ryan 2013). Yet, examples of above average need satisfaction and frustration scores are also observed. Each profile was associated with significantly different levels of stress, depression, anxiety, and life satisfaction but balance between the psychological needs was not evident.

Variable-oriented analyses

Evidence for the factor structure of the scores to the adapted ‘work version’ of the Psychological Need Satisfaction and Frustration Scale was shown. Results from a CFA support the hypothesized six factor structure with all except one item (.65) demonstrating strong factor loadings. These results support past work (Bartholomew et al. 2011a) and the theorized distinction between need satisfaction and need frustration (Vansteenkiste and Ryan 2013). Such evidence emphasizes the validity of scores provided to this scale and supports its use to explore, test and examine the propositions within BPNT.

Four hierarchical regression analyses for stress, depression, anxiety, and life satisfaction showed the unique and differential contribution that need frustration makes to ill-being and well-being at work ($R^2 = .14-.23$). These results support the important theoretical and applied distinction between, and implications of, need satisfaction and need frustration. That is, that psychological need frustration, rather than satisfaction, provides a better etiological mechanism underpinning psychopathological dysfunction whereas need satisfaction is a better mechanism for positive psychological functioning (Vansteenkiste and Ryan 2013). These findings support our hypothesis and indicate the unique and distinct role that psychological need frustration contributes when predicting negative indices of health and well-being identified in other contexts (e.g., Bartholomew et al. 2011b; Chen et al. 2015; Gunnell et al. 2013; Olafsen 2017). In addition, and extending the literature, the results from this study showed the individual contribution of each need to vary according to the outcome of interest.

By including the frustration of each basic psychological need, this study tests the unique contribution of each need as opposed to composite psychological need satisfaction and/or frustration scores. Frustration of the three basic psychological needs all demonstrated significant and positive relationships with symptoms of stress, depression, and anxiety when added to the model. Autonomy and competence frustration made the strongest contribution to perceptions of stress, whilst frustration of all three needs positively predicted depression. In contrast, competence frustration made the greatest contribution to perceptions of anxiety in this workforce. Only autonomy and competence frustration significantly and negatively predicted life satisfaction.

The addition of psychological need frustration to the model also altered the significant and negative relationships observed between basic need satisfaction and indicators of psychological dysfunction. The significant and negative relationships remained between autonomy need satisfaction and the negative indices of well-being but were suppressed in all cases. Relatedness need satisfaction only remained a significant negative predictor of depression, and competence need satisfaction, only significantly and negatively predicted anxiety. The relationships between need satisfaction and life satisfaction were also suppressed, with competence need satisfaction becoming non-significant. It is noteworthy that autonomy need satisfaction still made the greatest contribution to symptoms of depression.

An investigation of the interactions among need satisfaction and need frustration allowed for the additive effect on indices of ill-being to be tested (HO2). Results showed the interaction terms to explain additional, yet small, amounts of variance in symptoms of stress, depression, and anxiety but not life satisfaction. Such results add credence to the claim that psychological need frustration is distinct from a lack of need satisfaction and carries unique consequences for human health and well-being (Bartholomew et al. 2011b; Vansteenkiste and Ryan 2013). Plotting the significant interaction terms showed the impact that high and low levels of need satisfaction and frustration had on symptoms of stress, depression, and anxiety. Only the interaction between autonomy satisfaction and frustration contributed to firefighter’s symptoms of stress. As hypothesized, firefighters high in autonomy frustration and low in autonomy satisfaction experienced the greatest level of stress symptoms. In contrast, experiencing high need satisfaction in the face of high need frustration reduced the level of stress experienced. All three interaction terms were significant when predicting depressive symptoms, although it is notable that the need for autonomy had the strongest relationship with symptoms of depression. When high in autonomy frustration and low in autonomy satisfaction, the greatest levels of depressive symptoms were experienced. Yet, when firefighters were high in autonomy frustration, experiencing high

levels of autonomy satisfaction moderated the relationship with depressive symptoms. A similar pattern was observed for competence and relatedness, however, with slightly lower attenuating impact. The interactions between all three needs also contributed toward the prediction of anxiety with a pattern similar to that observed for depressive symptoms. Individuals high in need frustration and low in need satisfaction were most exposed to symptoms of anxiety, yet, being high in psychological need satisfaction moderated this relationship.

These results extend preliminary investigations into the effect of interactions between psychological need satisfaction and need frustration on exhaustion in young athletes (Bartholomew et al. 2011b). The findings of the present work align with those of Bartholomew et al., who found that higher autonomy satisfaction scores attenuate the effects of autonomy frustration on exhaustion. However, in this sport setting, the interaction between competence satisfaction and frustration made the strongest contribution to exhaustion. Here, high competence frustration overcame the protective impact of high competence satisfaction on exhaustion. These differences emphasize the importance of understanding the interplay between need satisfaction and need frustration within specific contexts. Similar to Bartholomew et al., the interactions only explained a relatively small amount of variance in the outcomes, however, the significant interactions offer further credence to the premise that perceptions of need satisfaction and frustration have unique predictive effects on indices of negative function.

It is noteworthy that of the seven significant interaction terms plotted only one demonstrated that being low in need frustration and high in need satisfaction led to the lowest experience of negative pathology, in this instance depressive symptoms. In contrast, individuals low in need frustration and low in need satisfaction experienced the same level of symptoms in the negative pathologies as those experiencing low need frustration and high need satisfaction. At the variable centred level, psychological need satisfaction did not reduce experiences of negative pathologies, rather it attenuated the positive relationship between need frustration and psychological dysfunction. Yet, what remains unclear is whether firefighters have profiles that include similar levels of need satisfaction and need frustration within the same psychological need. A question that person-oriented analyses provided further insight.

Person-oriented need satisfaction and frustration profiles

The latent profile analysis showed five different basic need satisfaction and frustration profiles. Two extreme profiles emerged that we characterized as being “High Satisfaction, Low Frustration” and “Low Satisfaction, Very High

Frustration” that sandwiched three further profiles. These profiles provide some indication that typically when need satisfaction or need frustration is high the opposite tends to be lower. Some limited support is offered to the premise that need satisfaction and frustration do operate in an asymmetrical way. That is, if need frustration is high, need satisfaction should be low but low need satisfaction does not necessitate high need frustration (Vansteenkiste and Ryan 2013). Profile 2 provides support for this proposition, with similar below average scores for competence satisfaction and frustration combined with above average autonomy and relatedness satisfaction scores and below average autonomy and relatedness frustration scores. However, there is also evidence that above average scores can be achieved in both need satisfaction and need frustration. For Profile 3 “Very High Competence Satisfaction, High Frustration”, z-scores indicate that both overall need satisfaction and overall need frustration were above average. In addition, Profiles 3, 4 and 5 entail above average scores for both relatedness satisfaction and relatedness frustration (e.g., Profile 4, $z=0.43$ & 0.99 respectively). Yet, it is noteworthy that only a small number of firefighters (51/2236) had scores that were 1 standard deviation or higher in both satisfaction and frustration of the same need. It is also plausible that firefighters may think of different events or experiences when completing survey items that tap need satisfaction and frustration. Therefore, although there is some evidence that above average levels of relatedness satisfaction and relatedness frustration might exist, future research is necessary to explore and corroborate this interplay including qualitative explorations of basic psychological need experiences and tests of the longitudinal or momentary relationships.

The implications for the psychological well-being of the basic psychological needs varied across the different profiles identified. Supporting propositions within SDT (Vansteenkiste and Ryan 2013) and complementing the present and previous person-oriented research (Laursen and Hoff 2006; Lindwall et al. 2017), higher levels of psychological dysfunction were exhibited by firefighters whose need frustration prevailed over need satisfaction. The “Low Satisfaction, Very High Frustration” consisted of 9% of our sample and had the highest levels of psychological dysfunction. In contrast, the “High Satisfaction, Low Frustration” profile consisted of 26% of our sample, and had the fewest symptoms of depression, stress, and anxiety and highest life satisfaction scores. The large number of significant differences, and the moderate to large effect sizes observed, attest to the unique relationship that each profile has with symptoms of psychological dysfunction and life satisfaction. Further emphasizing that small changes in the interplay between need satisfaction and frustration can relate to changes to human psychological functioning.

The establishment of basic psychological need profiles within a large workforce allowed the balance hypothesis to be tested (Sheldon and Neimiec 2006). Our findings indicate that participants with the most adaptive psychological well-being did not have balance in their levels of need satisfaction. Participants with Profiles 1 and 2 reported the least symptoms of stress, depression, and anxiety and highest scores for life satisfaction yet the z-scores and mean scores for basic psychological need satisfaction indicated variability across the needs. In Profile 1, z-scores were 0.59 above the mean for autonomy satisfaction, whereas the z score was 1.63 for relatedness satisfaction. For Profile 2, the z score for relatedness satisfaction was 1.31 but $-.23$ for competence satisfaction. Further, the most dysfunctional profile had the greatest balance for the satisfaction of the three needs, as determined by the summed differences between the needs. No previous research that we are aware of has considered the balance between need frustrations. However, our profiles indicated no clear support, with the most maladaptive profile having the most balance in need frustration and the most adaptive profile having the third most balance in need frustrations. These findings offer further credence to the findings of the only other study to have tested the balanced hypothesis in a work context. Dysvik et al. (2013) showed that balance failed to make a unique contribution to the well-being of 1254 Norwegian employees. Thus, and although some support in other contexts has been found for the balanced hypothesis (Sheldon and Niemiec 2006) evidence within an occupational context has not been reported.

Person oriented profiles can help employers identify ways to improve their employees need-based functioning and psychological well-being. Such detailed profiles indicate which needs are perceived to be satisfied and which are frustrated within the workforce. In this instance, the majority of our participants (65%) possessed profiles where need satisfaction was more prevalent than need frustration. Yet, 29% ($N=627$) of employees had profiles where need frustration was more prevalent than need satisfaction. In order to reduce symptoms of stress, depression, and anxiety, this need-based functioning can subsequently be targeted by identifying and changing the factors within the working environment that both reduce need frustration and enhance need satisfaction.

Limitations and future directions

Despite the highly original contribution that this research makes to the literature some important limitations need to be considered. The majority of statistical indicators were not able to differentiate and identify the optimal profile solution (e.g., 6 profiles could also have been statistically justified). As a result, our decision on the number of profiles was based on content-related indicators, which in turn are associated

with subjectivity. Even though we verified the stability of the 5-profile solution, via two separate latent profile analyses on a split data set, future research within different populations would help to establish the consistency of the profiles identified and whether these profiles are specific to operational firefighters.

Although a large sample size was obtained, the cross-sectional design fails to address the important factor of time and prevents statements about causal relationships being made. Prospective research designs will also help to test the proposition that low need satisfaction carries negative consequences over time, with need frustration having a more immediate impact by accelerating the deteriorating process (Vansteenkiste and Ryan 2013). Future research would also do well to test and examine the interplay and interactions between the basic psychological needs at different levels of generality (Ryan and Deci 2017). That is, test how basic psychological need satisfaction and psychological need frustration relate to, and influence each other, across global, contextual, and situational levels. Such examinations require considered use of measurement instruments and appropriate research designs to further scrutinise the dynamics of the basic psychological needs and identify the consequences for human functioning.

Conclusion

In a highly original study, variable and person-oriented analyses have been combined to address a void in the literature and provide a rigorous assessment of the interplay between need satisfaction and need frustration. Variable-oriented analyses showed psychological need frustration to be uniquely and positively related to psychological dysfunction, yet experiences of psychological need satisfaction moderated this negative relationship. Person-oriented analyses indicate that distinct profiles exist in a work setting that were strongly related to psychological dysfunction. Such detailed profiles provided some support for the theorized asymmetrical relationship between need satisfaction and frustration yet there was little evidence for the balance hypothesis within the basic psychological needs. Instead of being incompatible, variable and person-oriented approaches have informed each other and provided clarity about how to interpret real world psychological phenomena (Laursen and Hoff 2006). These important distinctions identified by the two approaches encourage critical reflection and provide deeper insight into the interplay between the basic psychological needs.

Funding Funding was provided by Chief Fire Officers Association (Grant No. RE-FH1085), FireFit Steering Group (Grant No.

RE-FH1085), Fire Service Research and Training Trust (Grant No. RE-FH1085).

Compliance with ethical standards

Conflict of interest Peter C. Rouse declares that he has no conflict of interest. Philip J. F. Turner is a member of the Fire and Rescue Service and a member of the FireFit Steering Group. Andrew G. Siddall declares that he has no conflict of interest. Julia Schmid declares that she has no conflict of interest. Martyn Standage has received a research grant from the Chief Fire Officers Association. James L. J. Bilzon has received research grants from the Fire Service Research and Training Trust, the Chief Fire Officers Association and the FireFit Steering Group.

Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: testing and interpreting interactions*. Newbury Park, CA: Sage.
- Álvarez, M. S., Balaguer, I., Castillo, I., & Duda, J. L. (2009). Coach autonomy support and quality of sport engagement in young soccer players. *The Spanish Journal of Psychology*, *12*(1), 138–148. <https://doi.org/10.1017/S1138741600001554>.
- Arbuckle, J. L. (2013). *Amos 22 user's guide*. Chicago, IL: SPSS.
- Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011a). Self-determination theory and diminished functioning. *Personality and Social Psychology Bulletin*, *37*(11), 1459–1473.
- Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2011b). Psychological need thwarting in the sport context: assessing the darker side of athletic experience. *Journal of Sport and Exercise Psychology*, *33*(1), 75–102. <https://doi.org/10.1177/0146167211413125>.
- Bergman, L. R., & Andersson, H. (2010). The person and the variable in developmental psychology. *Journal of Psychology*, *218*, 155–165.
- Bernard, D., Martin, J. J., & Kulik, N. (2014). Self-determination theory and well-being in the health care profession. *Journal of Applied Biobehavioral Research*, *19*(3), 157–170. <https://doi.org/10.1111/jabr.12023>.
- Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. *Sage focus editions*, *154*, 136.
- Byrne, B. (2006). *Structural equation modeling with EQS* (Vol. 2). New Jersey: Lawrence Erlbaum Associates.
- Campbell, R., Boone, L., Vansteenkiste, M., & Soenens, B. (2018). Psychological need frustration as a transdiagnostic process in associations of self-critical perfectionism with depressive symptoms and eating pathology. *Journal of Clinical Psychology*, *74*(10), 1775–1790. <https://doi.org/10.1002/jclp.22628>.
- Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E., Van der Kaap-Deeder, J., et al. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, *39*(2), 216–236. <https://doi.org/10.1007/s11031-014-9450-1>.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- 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.
- Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, *49*(1), 71–75.
- Dysvik, A., Kuvaas, B., & Gagne, M. (2013). An investigation of the unique, synergistic and balanced relationships between basic psychological needs and intrinsic motivation. *Journal of Applied Social Psychology*, *43*(5), 1050–1064. <https://doi.org/10.1111/jasp.12068>.
- Fernet, C. (2013). The role of work motivation in psychological health. *Canadian Psychology-Psychologie Canadienne*, *54*(1), 72–74. <https://doi.org/10.1037/a0031058>.
- Gillet, N., Forest, J., Benabou, C., & Bentein, K. (2015). The effects of organizational factors, psychological need satisfaction and thwarting, and affective commitment on workers’ well-being and turnover intentions. *Le Travail Humain*, *78*(2), 119–140.
- Gillet, N., Fouquereau, E., Forest, J., Brunault, P., & Colombat, P. (2012). The impact of organizational factors on psychological needs and their relations with well-being. *Journal of Business and Psychology*, *27*(4), 437–450.
- González, M. G., Niemiec, C. P., & Williams, G. C. (2014). *At the interface of work and health: a consideration of the health gradient using self-determination theory*. New York: Oxford University Press.
- Gunnell, K. E., Crocker, P. R., Wilson, P. M., Mack, D. E., & Zumbo, B. D. (2013). Psychological need satisfaction and thwarting: a test of basic psychological needs theory in physical activity contexts. *Psychology of Sport and Exercise*, *14*(5), 599–607. <https://doi.org/10.1016/j.psychsport.2013.03.007>.
- Gustafsson, H., Carlin, M., Podlog, L., Stenling, A., & Lindwall, M. (2018). Motivational profiles and burnout in elite athletes: a person-centered approach. *Psychology of Sport and Exercise*, *35*, 118–125. <https://doi.org/10.1016/j.psychsport.2017.11.009>.
- Haahr, M. (2018). True Random Number Service. Retrieved from random.org
- Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students’ motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of Sport and Exercise*, *16*, 26–36.
- Harvey, S. B., Milligan-Saville, J. S., Paterson, H. M., Harkness, E. L., Marsh, A. M., Dobson, M., et al. (2016). The mental health of fire-fighters: an examination of the impact of repeated trauma exposure. *Australian and New Zealand Journal of Psychiatry*, *50*(7), 649–658. <https://doi.org/10.1177/0004867415615217>.
- Haslam, C., & Mallon, K. (2003). A preliminary investigation of post-traumatic stress symptoms among firefighters. *Work & Stress*, *17*(3), 277–285.
- Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*(2), 227–239. <https://doi.org/10.1348/014466505X29657>.
- Howard, J., Gagné, M., Morin, A. J., & Van den Broeck, A. (2016). Motivation profiles at work: a self-determination theory approach. *Journal of Vocational Behavior*, *95*, 74–89. <https://doi.org/10.1016/j.jvb.2016.07.004>.
- Hu, L., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure equation analysis: conventional criteria versus new

- alternatives. *Structural Equation Modeling*, 6, 1–55. <https://doi.org/10.1080/10705519909540118>.
- Jahnke, S. A., Poston, W. S. C., Haddock, C. K., & Murphy, B. (2016). Firefighting and mental health: experiences of repeated exposure to trauma. *Work*, 53(4), 737–744.
- Laursen, B. P., & Hoff, E. (2006). Person-centered and variable-centered approaches to longitudinal data. *Merrill-Palmer Quarterly*, 52(3), 377–389.
- Lindwall, M., Ivarsson, A., Weman-Josefsson, K., Jonsson, L., Ntoumanis, N., Patrick, H., et al. (2017). Stirring the motivational soup: within-person latent profiles of motivation in exercise. *International Journal of Behavioral Nutrition and Physical Activity*, 14(1), 4. <https://doi.org/10.1186/s12966-017-0464-4>.
- Lindwall, M., Weman-Josefsson, K., Sebire, S. J., & Standage, M. (2016). Viewing exercise goal content through a person-oriented lens: a self-determination perspective. *Psychology of Sport and Exercise*, 27, 85–92.
- Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the depression anxiety stress scales*. Sydney: Psychology Foundation Monograph.
- Martela, F., & Ryan, R. M. (2016). The benefits of benevolence: basic psychological needs, beneficence, and the enhancement of well-being. *Journal of Personality*, 84(6), 750–764. <https://doi.org/10.1111/jopy.12215>.
- Masyn, K. (2013). Latent profile analysis and finite mixture modelling. In T. D. Little (Ed.), *The Oxford handbook of quantitative methods in psychology* (pp. 551–611). New York: Oxford University Press.
- Morin, A. J. S., & Wang, J. C. K. (2016). A gentle introduction to mixture modeling using physical fitness performance data. In N. Ntoumanis & N. Myers (Eds.), *An introduction to intermediate and advanced statistical analyses for sport and exercise scientists* (pp. 183–210). London: Wiley.
- Murphy, S. A., Beaton, R. D., Cain, K., & Pike, K. (1995). Gender differences in fire fighter job stressors and symptoms of stress. *Women and Health*, 22(2), 55–69. https://doi.org/10.1300/J013v22n02_04.
- Murphy, S. A., Beaton, R. D., Pike, K. C., & Johnson, L. (1999). Occupational stressors, stress responses, and alcohol consumption among professional firefighters: a prospective, longitudinal analysis. *International Journal of Stress Management*, 6(3), 179–196.
- Muthén, B., & Asparouhov, T. (2014). IRT studies of many groups: the alignment method. *Frontiers in Psychology*, 5, 978. <https://doi.org/10.3389/fpsyg.2014.00978>.
- Muthén, L. K., & Muthén, B. O. (1998–2017). *Mplus user's guide*. Los Angeles, CA.
- Olafsen, A. H. (2017). The implications of need-satisfying work climates on state mindfulness in a longitudinal analysis of work outcomes. *Motivation and Emotion*, 41(1), 22–37. <https://doi.org/10.1007/s11031-016-9592-4>.
- Pavot, W., & Diener, E. (2008). The satisfaction with life scale and the emerging construct of life satisfaction. *The Journal of Positive Psychology*, 3(2), 137–152.
- Pavot, W., & Diener, E. (2009). Review of the satisfaction with life scale. In E. Diener (Ed.), *Assessing well-being: the collected works of Ed Diener* (pp. 101–117). Dordrecht: Springer.
- Ryan, R. M., Bernstein, J. H., & Brown, K. W. (2010). Weekends, work, and well-being: psychological need satisfactions and day of the week effects on mood, vitality, and physical symptoms. *Journal of Social and Clinical Psychology*, 29(1), 95–122. <https://doi.org/10.1521/jscp.2010.29.1.95>.
- Ryan, R. M., & Deci, E. L. (2000). The darker and brighter sides of human existence: basic psychological needs as a unifying concept. *Psychological Inquiry*, 11(4), 319–338. https://doi.org/10.1207/S15327965PLI1104_03.
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: basic psychological needs in motivation, development, and wellness*. New York: Guilford Publications.
- Schultz, P. P., Ryan, R. M., Niemiec, C. P., Legate, N., & Williams, G. C. (2015). Mindfulness, work climate, and psychological need satisfaction in employee well-being. *Mindfulness*, 6(5), 971–985.
- Sheldon, K. M., & Niemiec, C. P. (2006). It's not just the amount that counts: balanced need satisfaction also affects well-being. *Journal of Personality and Social Psychology*, 91(2), 331.
- Standage, M., Curran, T., & Rouse, P. C. (2019). Self-determination-based theories of sport, exercise, and physical activity motivation. In T. S. Horn & A. L. Smith (Eds.), *Advances in sport and exercise psychology* (4th ed.). Champaign, IL: Human Kinetics.
- Standage, M., & Ryan, R. M. (2012). Self-determination theory and exercise motivation: facilitating self-regulatory processes to support and maintain health and well-being. In G. C. Roberts & D. C. Treasure (Eds.), *Advances in motivation in sport and exercise* (3rd ed., pp. 233–270). Champaign, IL: Human Kinetics.
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Needham Height, MA: Allyn & Bacon.
- Tabachnik, B., & Fidell, L. (2013). *Using multivariate statistics*. Boston, MA: Pearson.
- Trépanier, S.-G., Fernet, C., & Austin, S. (2015a). A longitudinal investigation of workplace bullying, basic need satisfaction, and employee functioning. *Journal of Occupational Health Psychology*, 20(1), 105. <https://doi.org/10.1037/a0037726>.
- Trépanier, S.-G., Forest, J., Fernet, C., & Austin, S. (2015b). On the psychological and motivational processes linking job characteristics to employee functioning: insights from self-determination theory. *Work & Stress*, 29(3), 286–305. <https://doi.org/10.1080/02678373.2015.1074957>.
- Turner, P., Siddall, A., Stevenson, R., Standage, M., & Bilzon, J. (2018). Lifestyle behaviours and perceived well-being in different fire service roles. *Occupational Medicine*, 68(8), 537–543. <https://doi.org/10.1093/occmed/kqy110>.
- Van den Broeck, A., Ferris, D. L., Chang, C.-H., & Rosen, C. C. (2016). A review of self-determination theory's basic psychological needs at work. *Journal of Management*, 42(5), 1195–1229. <https://doi.org/10.1177/0149206316632058>.
- Van den Broeck, A., Lens, W., De Witte, H., & Van Coillie, H. (2013). Unraveling the importance of the quantity and the quality of workers' motivation for well-being: a person-centered perspective. *Journal of Vocational Behavior*, 82(1), 69–78. <https://doi.org/10.1177/0149206316632058>.
- Van den Broeck, A., Vansteenkiste, M., Lens, W., & De Witte, H. (2010). Unemployed individuals' work values and job flexibility: an explanation from expectancy-value theory and self-determination theory. *Applied Psychology*, 59(2), 296–317. <https://doi.org/10.1111/j.1464-0597.2009.00391.x>.
- Vansteenkiste, M., Lens, W., Soenens, B., & Luyckx, K. (2006). Autonomy and relatedness among Chinese sojourners and applicants: conflictual or independent predictors of well-being and adjustment? *Motivation and Emotion*, 30(4), 273–282. <https://doi.org/10.1007/s11031-006-9041-x>.
- 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. <https://doi.org/10.1037/a0032359>.