



Testing the need for novelty as a candidate need in basic psychological needs theory

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Published online: 14 November 2019
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Abstract

The purpose of this research was to test novelty as a candidate basic psychological need according to the inclusion criteria established within basic psychological needs theory (BPNT). Two cross-sectional studies with 303 ($M_{\text{age}} = 33.50$, $SD = 12.95$; 58.41% female) and 598 ($M_{\text{age}} = 35.47$, $SD = 11.89$; 54.18% female) Spanish adults were conducted in physical exercise and general life contexts with the following aims: (1) to analyze relations between novelty satisfaction/frustration and well-being outcomes; (2) to examine the mediating role of motivation (autonomous, controlled, and amotivation) in these relations; and (3) to study whether these associations held regardless of the importance participants attached to the need for novelty, and their level of openness to new experiences. In Study 1, satisfaction of the need for novelty positively and directly predicted autonomous motivation and vitality in physical exercise, beyond the three existing basic needs. It also indirectly predicted enjoyment and vitality through autonomous motivation. There was little evidence that importance ratings for need for novelty moderated these relations. In Study 2, novelty satisfaction positively predicted, and novelty frustration negatively predicted, vitality, life satisfaction, and meaning in life. Openness to experience strengthened the relations between novelty satisfaction/frustration and outcomes. A similar pattern of effects was found for the three basic psychological needs. Results provide preliminary support of novelty as an additional candidate need in BPNT.

Keywords Basic psychological needs · Motivation · Well-being · Perceived variety · Personality

Introduction

We can all remember some novel experiences that made us to enjoy life and feel full of vitality and energy. A child who discovers snow for the first time, an adolescent who begins a romantic relationship, a young person that finds a new leisure or professional activity that he or she loves, an adult who travels to a new country or city, or an elderly person who meets his or her grandchild are clear examples of how novel experiences facilitate well-being, vitality, and life satisfaction at different life stages. But novelty can also be

found beyond these uniquely memorable experiences. Individuals have been shown to find interest and novelty even within mundane, everyday activities and contexts that serve to promote adaptive outcomes (e.g., Sansone et al. 1992). For example, people can find novelty in many daily activities, such as reading a new book, watching a new television series or movie, visiting a new restaurant or trying new food, hiking on a new footpath, doing a new activity in the school class or in the gym, being involved in a new project at work, or meeting new people. Recent research (González-Cutre et al. 2016) has proposed that novelty could be a basic and universal psychological need from the perspective of basic psychological needs theory (BPNT; Deci and Ryan 1985, 1991, 2000; Ryan and Deci 2017), whose satisfaction would be positively associated with well-being and human flourishing.

As this proposal is in its infancy, the objective of the present research was to provide more evidence in support of the need for novelty as an additional basic psychological need within BPNT. We report results from two studies testing

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the need for novelty as a candidate need according to the inclusion criteria established by Ryan and Deci (2017). This issue was addressed at the global (i.e., life) and contextual (i.e., physical exercise) levels to demonstrate the relevance of novelty need satisfaction to motivation, well-being, and behavior in different life domains.

Criteria for identifying a new basic psychological need

According to BPNT, one of the six mini-theories of self-determination theory (Ryan and Deci 2017), individuals' motivation toward behaviors and tasks, and their optimal functioning and well-being in general, is determined by the extent to which they are able to satisfy psychological needs. Beyond biological needs, satisfaction of psychological needs is necessary for optimal growth and functioning, while their persistent frustration may result in maladaptive outcomes like negative affect and ill-being (Ryan and Deci 2017). BPNT proposes three basic psychological needs: the needs for autonomy, competence, and relatedness. The need for autonomy refers to the need to experience actions as personally chosen and to feel that we are the origin of our own actions; the need for competence refers to the need for master and gain self-referenced success on tasks; and the need for relatedness reflects the need for interconnectedness with others and feeling understood and valued by them. Support for the three needs as 'basic' is based on theoretical principles and cross-cultural research, demonstrating that these three needs retain prominence atop lists of candidate needs (Sheldon et al. 2001).

Although there are different criteria for defining a need (e.g., Baumeister and Leary 1995), Ryan and Deci (2017) have formally established a set of inclusion criteria that should be met for candidate needs to be included within BPNT: (1) The satisfaction of a new candidate need should be strongly associated with psychological integrity, health, and well-being ('bright side' of people's functioning), and its frustration should be negatively associated with these outcomes and positively associated with ill-being and more impoverished functioning ('dark side' of people's functioning), over and above the variance explained by the existing needs; (2) A basic psychological need must indicate the specific experiences and behaviors that will lead to well-being. Therefore, definitions of the need must explicitly specify the types of activities and actions that will lead to enhanced psychological well-being; (3) The postulated basic psychological need must be essential to the interpretation of empirical phenomena, and, therefore, any new need should be a consistent mediator of relations between social and personal factors and individuals' motivational and psychosocial functioning. Specifically, while basic need satisfaction is hypothesized to be positively related to autonomous

motivation (i.e., acting out of choice and enjoyment) and adaptive consequences, basic need frustration is hypothesized to be positively associated with controlled motivation (i.e., acting for reward or feeling of guilt), amotivation (i.e., lack of motivation), and maladaptive consequences; (4) A candidate need should be a 'growth need' that works in synergy with the other basic psychological needs rather than a 'deficit' need that operates only when other basic psychological needs are thwarted. In fact, each need satisfaction facilitates the satisfaction of the others under most conditions, and therefore measures of satisfaction of basic psychological needs will be positively related; (5) A basic psychological need should be in the appropriate category of variables. It should be a precursor and not an outcome of the natural, inherent growth process of intrinsic motivation and organismic integration; and (6) A basic psychological need must operate universally for all people at all ages in all cultures. The effects of satisfaction versus frustration of basic psychological needs will be evidenced regardless of whether or not people explicitly desire or value these needs, and regardless of their sociocultural context.

Conceptual basis for the need for novelty

Consistent with these proposals, other candidate needs (e.g., meaning, self-esteem, security) have been rejected because they did not fulfill the inclusion criteria. Recent research has proposed new candidate basic psychological needs, such as benevolence (Martela and Ryan 2016) or nature relatedness (Baxter and Pelletier 2019), but more evidence is still necessary to establish their inclusion as basic needs in BPNT. Another candidate need that has recently stimulated the interest of BPNT researchers is the need for novelty. The need for novelty is defined as the need to experience something not previously experienced or that differs from the experiences that comprise a person's everyday routine (González-Cutre et al. 2016). According to González-Cutre et al. (2016), the need for novelty encompasses the inherent desire to seek out and engage in new activities, to feel new sensations, and to experience new contexts and situations. This need could be satisfied if it is the first time that a person faces the novel stimulus, or if a long time has passed since the last occasion in which the stimulus was presented, representing a change in the person's routine. Novelty need satisfaction could be promoted through providing people with experiences of novel activities, projects, contacts, environments, materials, or technologies. Novelty is conceptually distinct from, but related to, variety. If something is novel, it is also likely to vary with respect to previous experiences, but an experience can vary from previous experience without being necessarily be novel, such as going to the gym and alternating the use of different machines and exercises that are familiar (Sylvester et al. 2018).

González-Cutre et al. (2016) conducted an in-depth literature review to justify why the need for novelty should be included into the set of basic psychological needs within BPNT. They also analyzed the need for novelty from the perspective of constructs from other contemporary approaches to novelty including interest (Silvia 2006), curiosity (Kashdan 2004), sensation seeking (Zuckerman 1994), and perceived variety (Sylvester et al. 2014). As with many higher species, humans have demonstrable motivation to explore, take risks, and adapt to the new circumstances that the environment presents, needing a continuous evolution to survive, because systems that are not renewed tend to deplete and disappear (Kashdan and Silvia 2009). However, individual differences have been found in the way in which people face these novel situations. In this regard, Berlyne (1960) indicated that organisms explore their environments as a source of novelty, but if the environment does not provide sufficient stimulation, the organism will not satisfy their desire for change and novelty. Therefore, it is relevant to study the satisfaction or frustration of the need for novelty, which will depend to a large extent on the opportunities available in the environment.

González-Cutre et al. (2016) proposed novelty as a candidate basic psychological need within BPNT taking into account the important role of this variable in intrinsic motivation definitions (e.g., Deci and Ryan 1991, 2000). Deci and Ryan consistently identified seeking out novelty and unique challenges as a key defining characteristic of intrinsic motivation. However, they focused on autonomy and competence as the main need-related drivers of intrinsic motivation because of the recognized need for people to feel they are the origin of their own actions, and the need for people to develop effectance in their environment, respectively. Nevertheless, although novelty is a very prominent construct for intrinsic motivation, it has not been previously proposed as a basic psychological need, most likely because it was considered to be subsumed by the satisfaction of autonomy and competence needs.

However, although the needs for autonomy and novelty are related, they do not represent the same construct. It is possible that the need for novelty will be satisfied when the new stimulus arouses sufficient interest and it is experienced as autonomous, but previous research has shown that novelty accounted for unique variance in outcomes beyond autonomy (González-Cutre and Sicilia 2019). These results indicate that relations among variables involved in motivational processes would be better explained if researchers separated autonomy from novelty. Similarly, novelty and competence do not either represent the same construct (Loewenstein 1994). In fact, they are two complementary and important motivational variables that should be combined to achieve positive psychological states (Csikszentmihalyi 1990; González-Cutre and Sicilia 2019). People could

feel competent doing a task that is not novel, and they also could feel incompetent doing a novel task. In this sense, to separate novelty from competence is important to study how to create settings that satisfy both needs for optimal human motivation and wellness. If novel elements were introduced alongside familiar activities, people would have sufficient opportunity to experience competence when engaged with familiar tasks, but would also have the opportunity to experience novel stimuli that could satisfy their need for novelty.

Previous research on the need for novelty

Sheldon et al. (2001) carried out important preliminary research testing the validity of different candidate psychological needs. Although these authors did not directly test the need for novelty, they included two items related to new sensations and activities, and new sources of stimulation, in their pleasure-stimulation need. They showed that self-esteem, autonomy, competence, and relatedness were the most salient needs out of 10 candidates in satisfying events, and their satisfaction was positively associated with positive affect, and negatively associated with negative affect. The pleasure-stimulation need also emerged near the top of the list, after the three basic psychological needs and self-esteem, but it did not account for independent variance in affect responses associated with satisfying events.

Recently, González-Cutre et al. (2016) formally proposed that novelty could be a basic psychological need, and carried out two studies with Spanish participants, in general life and physical education contexts, to provide preliminary evidence for novelty need satisfaction in BPNT. González-Cutre et al. (2016) provided theoretical descriptions of the specific novelty satisfaction experiences and behaviors related to well-being that characterize the need for novelty. These descriptions are important in order to address Ryan and Deci's (2017) second criterion required for a candidate need to be included in BPNT. González-Cutre et al. (2016) also demonstrated through confirmatory factor analyses that novelty need satisfaction is a different, albeit related, construct from autonomy, competence, and relatedness need satisfaction. These results are in line with Ryan and Deci's (2017) propositions and fourth inclusion criterion for basic psychological needs. Moreover, González-Cutre et al. (2016) showed that novelty need satisfaction positively predicted life satisfaction and intrinsic motivation in physical education, slightly increasing the explained variance by the satisfaction of existing needs.

In addition, a study on Spanish students showed that satisfaction of autonomy, competence, and novelty positively predicted vitality, flow, and satisfaction in physical education (González-Cutre and Sicilia 2019). These studies (González-Cutre and Sicilia 2019; González-Cutre et al. 2016) demonstrated that novelty is associated with psychological

integrity and well-being, and therefore it would fulfill the ‘bright side’ of people’s functioning according to the first inclusion criterion.

González-Cutre and Sicilia (2019) also showed that a consideration of novelty as a basic psychological need could assist in understanding different components of intrinsic motivation. They found that satisfaction of the three basic psychological needs and novelty not only predicted adaptive outcomes directly, but also indirectly through intrinsic motivation. Although all needs were positively related to intrinsic motivation, novelty need satisfaction was the best predictor of intrinsic motivation to know (for learning and understanding). In this line, conceptualizing novelty satisfaction as a precursor of intrinsic motivation and outcomes could clarify the motivational processes that guide an optimal development. Therefore, the need for novelty would have a similar function to the three existing needs, and it would be placed in the same category of variables, as a precursor of the inherent growth process of intrinsic motivation, according to the fifth inclusion criterion.

Recently, Birdsell (2018) showed that satisfaction of the three basic psychological needs and novelty was positively correlated with different adaptive variables (e.g., satisfaction, engagement) in an English learning context with Japanese students. Inversely, frustration of the three basic psychological needs and novelty was negatively correlated with these variables. This study represents the first evidence that novelty frustration is negatively associated with well-being, consistent with the ‘dark side’ of people’s functioning established in the Ryan and Deci’s (2017) first inclusion criterion.

The present research

The objective of this research was to provide further evidence that the need for novelty could be an additional candidate need in BPNT. To this end, two studies were conducted, one focusing on individuals’ novel experiences in the context of exercise and other in their life in general. Specifically, the aims of this research were: (1) to replicate previous findings confirming that satisfaction of the need for novelty is related to well-being outcomes, beyond the three existing needs (Study 1 and 2); and extend these findings by testing the effect of novelty frustration on well-being outcomes (Study 2); (2) to examine the mediating role of motivation (autonomous, controlled, and amotivation) in the relations between satisfaction of the three basic psychological needs and the need for novelty and indices of well-being in a physical exercise context (Study 1); and (3) to test if novelty satisfaction and frustration were related to well-being regardless of whether people explicitly assigned importance to this need (Study 1 and 2).

Study 1

In this study, we tested relations among basic psychological needs, need for novelty, motivation, and two indices of well-being (enjoyment and vitality) in the exercise context. We tested whether satisfaction of the need for novelty was associated with outcomes relating to the ‘bright side’ of functioning consistent with Ryan and Deci’s (2017) first inclusion criterion. This analysis would also address the hypothesis that motivation would mediate effects of novelty on outcomes consistent with their third inclusion criterion. Specifically, we predicted that if individuals reported that their basic psychological needs were satisfied during exercise, they would be more likely to report more autonomous motivation, which would be, in turn, associated with positive consequences. However, if these needs are not satisfied, people would be more likely to report controlling motivation or amotivation, and then negative consequences. It was expected that satisfaction of the need for novelty would be positively related to autonomous motivation and forms of well-being, in a similar way to the three basic psychological needs (Hypothesis 1).

Moreover, participants were asked for the explicit importance assigned to each of the basic psychological needs and the need for novelty in their life, to test the moderating role of this variable. We expected that novelty importance would not moderate relations between novelty need satisfaction, motivation, and well-being outcomes (Hypothesis 2). This hypothesis was proposed because, according to BPNT postulates, effects of satisfaction of basic psychological needs should be present regardless of whether or not people value the needs (Chen et al. 2015; Ryan and Deci 2017: inclusion criterion 6).¹

Method

Participants and procedure

Participants were 303 adults (126 males, 177 females) aged 18 to 80 years ($M = 33.50$, $SD = 12.95$) from four Spanish cities. The sample was classified in low (17.2%), medium (79.8%), and high (3%) socioeconomic status based on self-reported family income. Participants reported having their highest education levels as university education (60.4%), secondary school education (26.1%), primary education

¹ We also tested a supplementary hypothesis about need importance and need satisfaction in satisfying life events that was not directly germane to the current article, but may be of peripheral interest to scholars of basic psychological needs theory. This information is provided in Appendix 1.

(11.2%), and not completed primary education (2.3%). The majority (97.0%) of participants were Caucasian, with 1.7% African, 1.0% South American, and 0.3% Asian.

This study was approved by the ethical board of Miguel Hernández University of Elche. Two researchers with expertise in administering psychological tests recruited participants from university, sports centers, and social and leisure centers in person. Participants were informed that they would participate in a study requiring them to complete a survey on different factors related to motivation in physical exercise and life, and were asked to provide written consent to participate in advance of completing the survey.

Measures

Need satisfaction in exercise

We used the Basic Psychological Needs in Exercise Scale (BPNES; Vlachopoulos and Michailidou 2006) translated into Spanish (Moreno et al. 2008a), including items to measure novelty need satisfaction from the latest version of the Novelty Need Satisfaction Scale (NNSS; González-Cutre and Sicilia 2019). This instrument comprises 17 items which correspond to autonomy (four items, e.g., “The way I exercise is in agreement with my choices and interests”), competence (four items, e.g., “I feel exercise is an activity which I do very well”), relatedness (four items, e.g., “My relationships with the people I exercise with are close”), and novelty (five items, e.g., “When I exercise, I frequently feel there are novelties for me”). Responses were provided on 5-point scales (1 = *totally disagree* and 5 = *totally agree*).

Exercise motivation

We used the Spanish version (González-Cutre et al. 2010) of the Behavioural Regulation in Exercise Questionnaire (BREQ-3; Markland and Tobin 2004; Wilson et al. 2006). This instrument comprises 23 items measuring intrinsic regulation (four items, e.g., “I exercise because it’s fun”), integrated regulation (four items, e.g., “I consider exercise a fundamental part of who I am”), identified regulation (three items, e.g., “I value the benefits of exercise”), introjected regulation (four items, e.g., “I feel guilty when I don’t exercise”), external regulation (four items, e.g., “Because other people say I should”), and amotivation (four items, e.g., “I don’t see why I should have to exercise”). Responses were provided on 5-point scales (0 = *totally disagree* and 4 = *totally agree*). Cronbach alpha values for these scales ranged from .73 to .94 in the present study. Autonomous motivation was calculated as the sum of intrinsic regulation weighted by three, integrated regulation weighted by two, and identified regulation. Similarly, controlled motivation

was computed as the sum of external regulation weighted by two and introjected regulation (e.g., Hagger et al. 2014).

Enjoyment in physical activity

The Spanish version (Moreno et al. 2008b) of the Physical Activity Enjoyment Scale (PACES; Motl et al. 2001) was used. Participants were presented with the initial stem: “When I am active...” followed by 16 items (e.g., “I enjoy it”, “It frustrates me”, “It’s very pleasant”) with responses provided on 5-point scales (1 = *disagree a lot* and 5 = *agree a lot*).

Vitality in exercise

The Spanish version (Castillo et al. 2017) of the Subjective Vitality Scale (SVS; Bostic et al. 2000; Ryan and Frederick 1997) was used. This scale was preceded by the stem “When I exercise...” and composed of six items (e.g., “I feel alive and vital”, “I feel energized”), with responses provided on 7-point scales (1 = *not at all true* and 7 = *very true*).

Need importance in general life

Direct items of the validated Spanish version (González-Cutre et al. 2015) of the Basic Need Satisfaction in General Scale (BNSG-S; Gagné 2003) were used. The items of this scale were interspersed with items to measure the importance assigned to satisfaction of the need for novelty (NNSS; González-Cutre and Sicilia 2019). Participants indicated the importance assigned to the satisfaction of the needs for autonomy (three items, e.g., “To be free to decide for myself how to live my life”), competence (three items, e.g., “To feel a sense of accomplishment from what I do”), relatedness (five items, e.g., “To like the people I interact with”), and novelty (five items, e.g., “To feel I do novel things”). Responses to each item were provided on 7-point scales (1 = *not at all true* and 7 = *very true*).

Data analysis

First, two path analyses were carried out to verify the hypothesized predictive relations among variables in the exercise context. In the first path analysis, only the three basic psychological needs were included at the first level of prediction, whereas in the second path analysis we also included the need for novelty. This stepwise analysis was conducted to examine the unique contribution of novelty need satisfaction, compared with the basic needs stipulated in BPNT. The analysis was controlled for gender, age, socio-economic status, and education level.

The models were estimated using the AMOS 24 statistical package using a maximum likelihood method with

parameters estimated using bootstrapped standard errors with 5000 replications. Indirect effects were estimated using Preacher and Hayes' (2008) methods with bootstrapped standard errors and standardized estimates (β). Goodness of fit of the proposed models with the data was evaluated using multiple criteria: comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) plus its 90% confidence interval (CI), and the standardized root mean square residual (SRMR). Values approaching or exceeding .95 for the CFI and TLI, equal to or less than .06 for the RMSEA, and equal or less than .08 for the SRMR were considered indicative of good fit (Hu and Bentler 1999).

Second, we tested the moderating effect of need importance on relations between the need satisfaction constructs and motivation and well-being. Specifically, we tested the two-way interaction of each need satisfaction construct and each moderator on motivation and well-being. Simple slope tests were conducted to test the effect of need satisfaction on motivation and well-being at different meaningful values of the moderator (Dawson 2014): low (-2 SD, -1 SD), mean, and high ($+1$ SD, $+2$ SD). In each regression model, the mean centered score for each of the four need satisfaction constructs, the moderator (the corresponding need importance construct), and the interaction term, computed by multiplying the relevant need satisfaction construct by the moderator, were entered as independent predictors of motivation and well-being. The Benjamini–Hochberg procedure (Benjamini and Hochberg 1995) with a false discovery rate of .05 was used in this analysis to reduce the risk of false positives due to multiple comparisons.²

Results

Path analysis in exercise

Table 1 shows descriptive statistics, alpha coefficients, and correlations among variables in the exercise context. Satisfaction of the need for novelty was positively correlated with autonomous motivation, enjoyment and vitality, and negatively with controlled motivation and amotivation, with similar values to those obtained by the three basic psychological needs.

Goodness of fit indices for the path analysis of the model with the three basic psychological needs as predictors of motivational and well-being outcomes [$\chi^2(11, N=303)=10.24, p=.509$; CFI=.99; TLI=.99; RMSEA=.001 (90% CI .001–.057); SRMR=.022], and

the model that also included the need for novelty alongside the basic needs [$\chi^2(15, N=303)=12.67, p=.628$; CFI=.99; TLI=.99; RMSEA=.001 (90% CI .001–.046); SRMR=.020], exhibited adequate fit with the data. Standardized parameter estimates and explained variances (R^2) for both models, with their 95% confidence intervals estimated by bootstrapping, are presented in Fig. 1. Results revealed that the inclusion of novelty need satisfaction in the model explained unique variance in autonomous motivation and vitality, and attenuated effects of basic need satisfaction on these variables.

Specifically, results of the second path analysis showed that satisfaction of the need for competence positively predicted autonomous motivation, and negatively predicted controlled motivation and amotivation. Satisfaction of the need for relatedness positively predicted autonomous motivation and negatively predicted amotivation. Satisfaction of the need for novelty positively predicted autonomous motivation. After the inclusion of novelty satisfaction in the model, the relation between autonomy satisfaction and autonomous motivation was reduced and no longer significant.³

On the other hand, autonomous motivation positively predicted enjoyment and vitality. In addition, satisfaction of the need for competence positively predicted enjoyment and vitality, while satisfaction of the need for novelty positively predicted vitality. We also found indirect effects of competence ($\beta=.17, p<.001$), relatedness ($\beta=.08, p<.001$), and novelty ($\beta=.09, p<.001$) satisfaction on enjoyment through autonomous motivation. Similarly, there were indirect effects of competence ($\beta=.23, p<.001$), relatedness ($\beta=.10, p<.001$), and novelty ($\beta=.11, p<.001$) satisfaction on vitality, again through autonomous motivation. Bootstrapping analysis showed that the different estimates were sufficiently robust.

The model was controlled for gender, age, socioeconomic status, and education level, and the relations between need satisfaction, motivation, and outcomes remained significant. Gender positively predicted enjoyment ($\beta=.14, p=.002$) and vitality ($\beta=.07, p=.045$), age positively predicted autonomous motivation ($\beta=.13, p=.005$), socioeconomic status positively predicted enjoyment ($\beta=.14, p=.005$), and education level positively predicted autonomous motivation ($\beta=.15, p=.001$) and vitality ($\beta=.10, p=.020$), and negatively predicted controlled motivation ($\beta=-.16, p=.020$) and amotivation ($\beta=-.16, p=.018$).

The moderation analysis (Appendix 2, see Table 4) of the relations between need satisfaction and motivation showed

² Data files, analysis output files, and interaction plots are available online at <https://osf.io/jwx57/>.

³ An inspection across the different types of motivation revealed that this change was probably because autonomy satisfaction only predicted intrinsic motivation whereas novelty satisfaction predicted intrinsic motivation and integrated regulation.

Table 1 Descriptive statistics, alpha coefficients, and correlations among study variables in the exercise context

Variables	Range	<i>M</i>	<i>SD</i>	α	1	2	3	4	5	6	7	8
1. Gender ^a	1–2	–	–	–		.06	.03	–.07	.04	–.07	.06	.02
2. Age	18–80	33.50	12.95	–			–.08	–.53**	.01	–.16**	–.13*	–.09
3. Socioeconomic ^b	1–3	–	–	–				.29**	.08	.13*	.11*	.06
4. Education ^c	1–4	–	–	–					.08	.11	.04	.08
5. Autonomy imp.	1–7	6.65	.58	.77						.51**	.45**	.54**
6. Competence imp.	1–7	6.24	.79	.77							.49**	.71**
7. Relatedness imp.	1–7	6.12	.77	.75								.49**
8. Novelty imp.	1–7	6.05	.95	.92								
9. Autonomy sat.	1–5	3.86	.97	.86								
10. Competence sat.	1–5	3.47	1.00	.87								
11. Relatedness sat.	1–5	4.00	1.07	.95								
12. Novelty sat.	1–5	3.30	1.05	.94								
13. Autonomous	0–24	18.27	5.70	–								
14. Controlled	0–12	2.13	2.15	–								
15. Amotivation	0–4	.36	.70	.79								
16. Enjoyment	1–5	3.77	.99	.93								
17. Vitality	1–7	5.13	1.33	.81								

Variables	Range	<i>M</i>	<i>SD</i>	α	9	10	11	12	13	14	15	16	17
1. Gender ^a	1–2	–	–	–	–.17**	–.15*	–.16**	–.10	–.19**	.08	.08	.02	–.08
2. Age	18–80	33.50	12.95	–	–.02	–.21**	–.01	–.08	–.06	.18**	.01	–.15*	–.14*
3. Socioeconomic ^b	1–3	–	–	–	.07	.14*	.04	.04	.05	–.10	.02	–.07	.07
4. Education ^c	1–4	–	–	–	.14*	.23**	.11*	.10	.21**	–.24**	–.14*	.16**	.26**
5. Autonomy imp.	1–7	6.65	.58	.77	.16**	.13*	.15*	.12*	.16**	–.12*	–.11*	.12*	.22**
6. Competence imp.	1–7	6.24	.79	.77	.24**	.30**	.22**	.25**	.29**	–.03	–.11	.29**	.37**
7. Relatedness imp.	1–7	6.12	.77	.75	.14*	.11*	.14*	.08	.07	–.04	–.05	.19**	.15*
8. Novelty imp.	1–7	6.05	.95	.92	.29**	.28**	.28**	.41**	.32**	–.08	–.17**	.31**	.43**
9. Autonomy sat.	1–5	3.86	.97	.86		.72**	.67**	.66**	.63**	–.27**	–.28**	.41**	.61**
10. Competence sat.	1–5	3.47	1.00	.87			.52**	.61**	.66**	–.28**	–.29**	.47**	.66**
11. Relatedness sat.	1–5	4.00	1.07	.95				.55**	.54**	–.21**	–.32**	.30**	.50**
12. Novelty sat.	1–5	3.30	1.05	.94					.58**	–.15*	–.22**	.37**	.62**
13. Autonomous	0–24	18.27	5.70	–						–.30**	–.53**	.53**	.76**
14. Controlled	0–12	2.13	2.15	–							.29**	–.18**	–.26**
15. Amotivation	0–4	.36	.70	.79								–.25**	–.40**
16. Enjoyment	1–5	3.77	.99	.93									.58**
17. Vitality	1–7	5.13	1.33	.81									

* $p < .05$; ** $p < .01$

^aGender coded as 1 = Male, 2 = Female

^bSocioeconomic status coded as 1 = Low, 2 = Medium, 3 = High

^cEducation level coded as 1 = Non completed primary education, 2 = Completed primary education, 3 = Completed secondary school education, 4 = University degree

Imp. = Importance; Sat. = Satisfaction

that four interaction terms (for competence satisfaction x competence importance on controlled motivation and amotivation, and for novelty satisfaction x novelty importance on autonomous motivation and amotivation) obtained a p value below .05. However, these p values were higher than their corresponding Benjamini–Hochberg critical values, or

the simple slopes were non-significant at the different values of the moderator, except for the interaction term for competence satisfaction x competence importance on controlled motivation. The interaction plot (see at <https://osf.io/jwx57>) showed lower values of controlled motivation when competence satisfaction was high and competence importance were

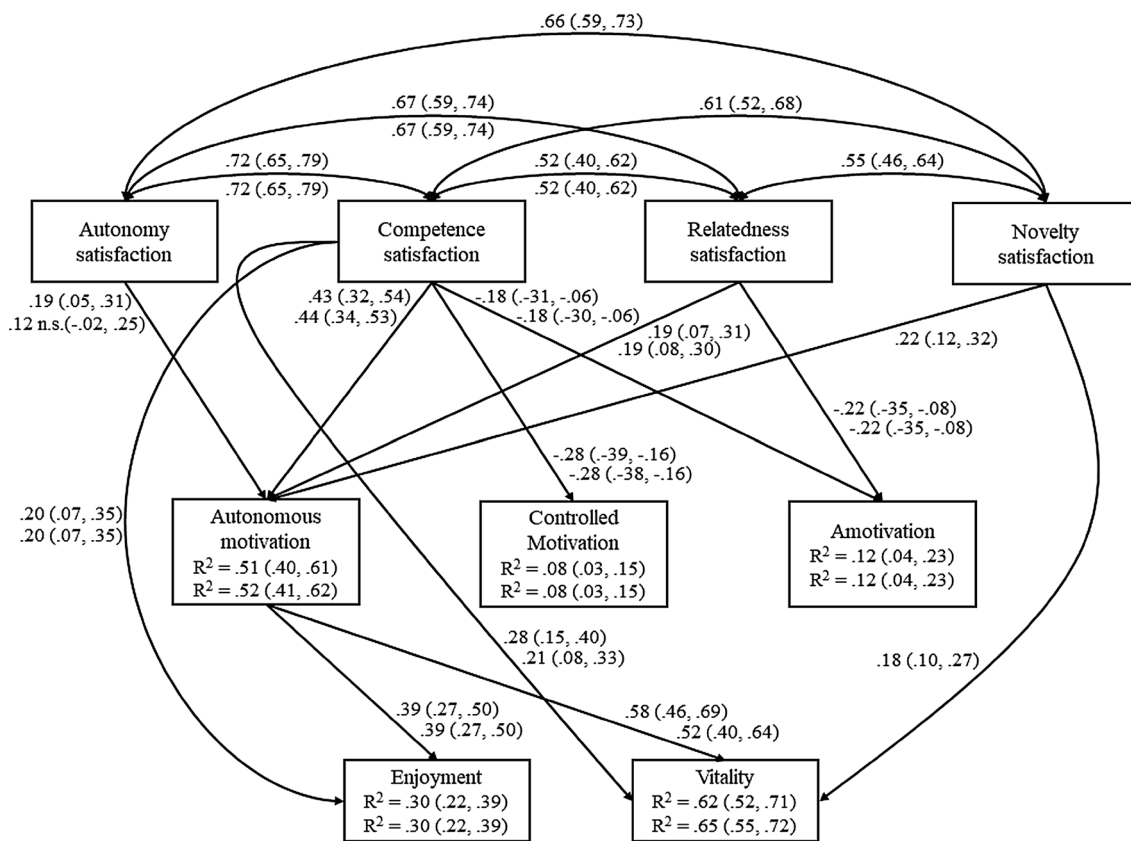


Fig. 1 Path analysis of the relations among basic psychological need satisfaction, novelty need satisfaction, motivation, and well-being in exercise. The values in the top line for each relation correspond to

the model that does not include the need for novelty. The numbers in parentheses show the 95% confidence intervals estimated by bootstrapping. *n.s.* not significant

low. The moderation analysis also showed that the relations between need satisfaction and well-being outcomes were not moderated by the importance assigned to each need.

Discussion

Results of the path analysis showed small unique effects of novelty need satisfaction on autonomous motivation and well-being in an exercise context, beyond the three existing basic psychological needs, consistent with our first hypothesis and Ryan and Deci’s (2017) first criterion for a candidate need to be considered a basic need in BPNT. The mediating role of autonomous motivation in this process was also demonstrated, providing some evidence to support Ryan and Deci’s (2017) third inclusion criterion. However, to provide a more complete test of this third criterion with respect to the need for novelty, future research should analyze whether novelty satisfaction/frustration serves to mediate relations between social factors (e.g., autonomous and controlling interpersonal styles), motivation, and outcomes.

Concerning our second hypothesis, current findings also showed that novelty satisfaction has positive effects on autonomous motivation and well-being regardless of participants’ importance attached to novelty, consistent with previous studies that analyze the importance assigned to the three basic psychological needs (Chen et al. 2015), and Ryan and Deci’s (2017) sixth inclusion criterion.

Study 2

The present study was designed to examine the moderating role of explicit importance assigned to novelty on the relations between novelty satisfaction and frustration and different indicators of well-being in a general life context: vitality, life satisfaction, and presence of meaning (“sense made of, and significance felt regarding, the nature of one’s being and existence”; Steger et al. 2006, p. 81). We also analyzed the moderating role of openness to experience as a personality trait linked to preference for novelty (Costa and McCrae 1992). For this purpose, we developed items to

measure novelty frustration, having in mind the importance of the need frustration construct in BPNT.

Considering Ryan and Deci's (2017) first inclusion criterion, we expected that novelty satisfaction positively predicted, and novelty frustration negatively predicted, well-being outcomes (Hypothesis 1). We also expected that importance assigned to the need for novelty and openness to experience would not moderate these relations (Hypothesis 2), in line with Ryan and Deci's (2017) sixth inclusion criterion.

Participants and procedure

Participants were 598 adults (274 males, 324 females) aged 18 to 75 years ($M=35.47$, $SD=11.89$) from 35 Spanish provinces. The sample was classified as low (16.2%), medium (81.8%), and high (2%) in socioeconomic status based on self-reported family income. Participants' highest attained education level was university education (70.2%), secondary school education (21.6%), primary education (7%), and not completed primary education (1.2%). All the participants were Caucasian.

This study was approved by the ethical board of Miguel Hernández University of Elche. Data were collected through an online questionnaire. The questionnaire was distributed via E-mail and social media outlets: Facebook, Twitter, and WhatsApp. Participants were informed that they would participate in a study about motivation in life, and were asked to provide consent to participate in advance of completing the questionnaire.

Measures

Need satisfaction and frustration

We used the Spanish version of the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al. 2015). This scale comprises 24 items distributed into six factors with four items each: autonomy satisfaction (e.g., "I feel a sense of choice and freedom in the things I undertake"), autonomy frustration (e.g., "Most of the things I do feel like I have to"), competence satisfaction (e.g., "I feel confident that I can do things well"), competence frustration (e.g., "I feel insecure about my abilities"), relatedness satisfaction (e.g., "I feel that the people I care about also care about me"), and relatedness frustration (e.g., "I feel excluded from the group I want to belong to"). The items of this scale were interspersed with the five items of the latest version of the Novelty Need Satisfaction Scale (NNSS; González-Cutre and Sicilia 2019; e.g., "I frequently feel there are novelties for me"), and with five items that were developed to measure novelty frustration: "What I do is repetitive", "I feel that the same situations always occur", "I feel monotony", "I feel

what I do is routine", "I feel that I always do the same". These items were elaborated following the same procedure used by González-Cutre et al. (2016) to develop the measure of novelty satisfaction. We initially developed a set of nineteen candidate items that were reviewed by three experts in BPNT who were not members of the research group. For each item, the experts assessed content and face validity, representativeness, uniqueness, and clarity. After their suggestions, and taking into account the structure and content of the NNSS, five items were retained to form the measure of novelty frustration. Responses were provided on 5-point scales (1 = *not true at all* and 5 = *completely true*). Cronbach alpha values for these scales ranged from .75 to .89 in the present study.

Vitality

The Spanish version (Castillo et al. 2017) of the Subjective Vitality Scale (SVS; Bostic et al. 2000; Ryan and Frederick 1997) was used. This scale was preceded by the stem "In my life..." and composed of six items (e.g., "I have energy and spirit"), with responses provided on 7-point scales (1 = *not at all true* and 7 = *very true*). Cronbach's alpha for this scale was .92 in the present study.

Life satisfaction

We employed the Spanish version (Atienza et al. 2000) of the Satisfaction with Life Scale (SWLS; Diener et al. 1985). The scale comprises five items (e.g., "I am satisfied with my life") with responses provided on 5-point scales (1 = *strongly disagree* and 5 = *strongly agree*). The Cronbach alpha value for this scale was .87 in the present study.

Meaning

We measured the presence of meaning in life with the Spanish version (Steger et al. 2008) of the Meaning in Life Questionnaire (MLQ; Steger et al. 2006). This factor is comprised by five items (e.g., "My life has a clear sense of purpose") with responses provided on 7-point scales (1 = *absolutely untrue* and 7 = *absolutely true*). Cronbach's alpha for this scale was .79 in the present study.

Need importance

The 12 items of need satisfaction from the Spanish version of the BPNSFS (Chen et al. 2015), and the five items of the NNSS (González-Cutre and Sicilia 2019), were adapted to assess the importance individuals assigned to the satisfaction of the needs for autonomy (e.g., "to feel that my decisions reflect what I really want"), competence (e.g., "to feel capable at what I do"), relatedness ("to feel close and connected

with other people who are important to me”), and novelty (“to feel I do novel things”). Responses were provided on 5-point scales (1 = *not true at all* and 5 = *completely true*). Cronbach alpha values for these scales ranged from .88 to .93 in the present study.

Openness to experience

We used four items from the International Personality Item Pool (IPIP; Goldberg et al. 2006) that measure adventurousness (preference for novelty), a construct similar to that one included in the openness to experience dimension of the Revised NEO Personality Inventory (NEO-PI-R; Costa and McCrae 1992): “I prefer novelty to routine”, “I like to visit new places”, “I am interested in many things”, and “I like to begin new things”. Responses were provided on 5-point scales (1 = *very inaccurate* and 5 = *very accurate*). The Cronbach alpha value for this scale was .71 in the present study.

Data analysis

First, as we newly-developed items to measure novelty frustration, we conducted two confirmatory factor analyses (CFA) of the BPNSFS including the two novelty subscales. We tested an eight-factor correlated structure and a higher-order model (i.e., with higher order satisfaction and frustration factors). The composite reliability coefficient and average variance extracted for the novelty frustration scale were also provided. Second, we calculated descriptive statistics and correlations among all study variables. Third, we analyzed the relations between the need satisfaction and frustration constructs and different indicators of well-being (vitality, life satisfaction, and meaning) using linear multiple regression analyses. In line with previous studies (Chen et al. 2015), we examined the contribution of need satisfaction and frustration in separate analyses to avoid problems with multicollinearity when putting all the need satisfaction and need frustration constructs in the same analysis. The regression analyses were controlled for gender, age, socioeconomic status, and education level.

We also tested the moderating effect of need importance and openness to experience on relations between the need satisfaction and frustration constructs and well-being. Specifically, we tested the two-way interaction effect between each need satisfaction and frustration construct and each moderator, and simple slope tests were conducted at different meaningful values of the moderator (Dawson 2014): low (-2 SD, -1 SD), mean, and high ($+1$ SD, $+2$ SD). In each regression model the mean centered score for each of the four need satisfaction or need frustration constructs, the moderator (the corresponding need importance construct or openness to experience), and the interaction term, computed by multiplying the relevant need satisfaction or frustration

construct by the moderator were entered as independent predictors of well-being.

As we conducted multiple moderation analyses, we used the Benjamini–Hochberg procedure with a false discovery rate of .05 to protect from type I error inflation (see Benjamini and Hochberg 1995). Analyses were grouped according to the two moderators (need importance and openness to experience) and the three outcomes (vitality, life satisfaction, and meaning).⁴

Results

Preliminary analysis

The eight-factor correlated model of the BPNSFS, including the novelty satisfaction and frustration subscales, showed acceptable fit with the data [$\chi^2(499, N=598)=1189.56$, $p < .001$; CFI = .94; TLI = .93; RMSEA = .048 (90% CI .045–.052); SRMR = .044]. In this model, all the correlations among the need satisfaction and frustration constructs were statistically significant ($p < .001$) and medium-to-large in size, according to BPNT postulates. Negative correlations ranged from $-.76$ (between relatedness satisfaction and relatedness frustration) to $-.35$ (between relatedness frustration and novelty satisfaction), and positive correlations ranged from .43 (between relatedness satisfaction and novelty satisfaction) to .79 (between autonomy frustration and novelty frustration).⁵ The correlation between novelty satisfaction and novelty frustration was $-.72$. Factor loadings for novelty frustration were higher than .68. Composite reliability (.89) and average variance extracted (.62) values were acceptable for novelty frustration. The higher-order model also exhibited acceptable fit indices [$\chi^2(518, N=598)=1669.70$, $p < .001$; CFI = .90; TLI = .89; RMSEA = .061 (90% CI .058–.064); SRMR = .068], with a correlation between need satisfaction and need frustration of $-.83$.⁶

⁴ Data files, analysis output files, and interaction plots are available online at <https://osf.io/jwx57/>.

⁵ Considering the high correlation found between autonomy need frustration and novelty need frustration, we tested an alternative model in which the items of these two constructs indicated a single latent variable. Fit indices [$\chi^2(506, N=598)=1444.08$, $p < .001$; CFI = .92; TLI = .91; RMSEA = .056 (90% CI .052–.059); SRMR = .052] indicated poorer fit for this model than those obtained for the eight-factor correlated model.

⁶ Although this correlation was high, if we removed the two novelty subscales from this model, the correlation was higher ($-.88$) and the fit indices were similar [$\chi^2(245, N=598)=870.95$, $p < .001$; CFI = .90; TLI = .89; RMSEA = .065 (90% CI .061–.070); SRMR = .064].

Table 2 Descriptive statistics and correlations among study variables in the general life context

Variables	Range	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
1. Gender ^a	1–2	–	–		.06	.02	.02	.10*	.13**	.14**	.10*	.03	–.04
2. Age	18–80	35.47	11.89			.09*	–.31**	–.18**	–.13**	–.08	–.02	–.05	–.07
3. Socioeconomic ^b	1–3	–	–				.13**	.10*	.13**	.11**	.06	.03	.10**
4. Education ^c	1–4	–	–					.16**	.07	.12**	.04	.03	.01
5. Autonomy imp.	1–5	4.31	.66						.79**	.60**	.64**	.45**	.44**
6. Competence imp.	1–5	4.52	.58							.67**	.55**	.43**	.33**
7. Relatedness imp.	1–5	4.54	.58								.38**	.30**	.29**
8. Novelty imp.	1–5	3.96	.80									.58**	.28**
9. Openness	1–5	4.20	.65										.34**
10. Autonomy sat.	1–5	3.75	.78										
11. Competence sat.	1–5	4.23	.70										
12. Relatedness sat.	1–5	4.26	.71										
13. Novelty sat.	1–5	3.44	.84										
14. Autonomy frust.	1–5	2.56	.88										
15. Competence frust.	1–5	2.10	.87										
16. Relatedness frust.	1–5	1.72	.74										
17. Novelty frust.	1–5	2.57	.90										
18. Vitality	1–7	5.07	1.26										
19. Life satisfaction	1–5	3.74	.83										
20. Meaning	1–7	4.76	1.14										

Variables	Range	<i>M</i>	<i>SD</i>	11	12	13	14	15	16	17	18	19	20
1. Gender ^a	1–2	–	–	–.10*	.05	–.04	.01	.10*	.01	.09*	–.12**	.01	–.02
2. Age	18–80	35.47	11.89	–.01	–.08	.03	.15**	–.06	.18**	.01	.01	–.02	.13**
3. Socioeconomic ^b	1–3	–	–	.17**	.13**	.11**	–.08	–.17**	–.18**	–.10**	.10**	.22**	.07
4. Education ^c	1–4	–	–	–.01	.07	.09*	–.05	–.04	–.13**	–.05	–.06	.08*	–.06
5. Autonomy imp.	1–5	4.31	.66	.42**	.31**	.40**	–.28**	–.26**	–.26**	–.26**	.44**	.38**	.33**
6. Competence imp.	1–5	4.52	.58	.41**	.32**	.33**	–.17**	–.20**	–.23**	–.16**	.38**	.33**	.31**
7. Relatedness imp.	1–5	4.54	.58	.31**	.52**	.26**	–.15**	–.20**	–.33**	–.15**	.27**	.34**	.25**
8. Novelty imp.	1–5	3.96	.80	.37**	.19**	.51**	–.15**	–.18**	–.12**	–.26**	.43**	.24**	.29**
9. Openness	1–5	4.20	.65	.51**	.27**	.47**	–.17**	–.23**	–.17**	–.23**	.38**	.23**	.26**
10. Autonomy sat.	1–5	3.75	.78	.59**	.49**	.57**	–.58**	–.51**	–.42**	–.52**	.60**	.61**	.49**
11. Competence sat.	1–5	4.23	.70		.51**	.50**	–.37**	–.62**	–.41**	–.42**	.54**	.49**	.43**
12. Relatedness sat.	1–5	4.26	.71			.38**	–.31**	–.39**	–.61**	–.36**	.36**	.45**	.35**
13. Novelty sat.	1–5	3.44	.84				–.39**	–.37**	–.29**	–.64**	.59**	.48**	.44**
14. Autonomy frust.	1–5	2.56	.88					.54**	.47**	.66**	–.42**	–.42**	–.33**
15. Competence frust.	1–5	2.10	.87						.52**	.58**	–.53**	–.52**	–.37**
16. Relatedness frust.	1–5	1.72	.74							.48**	–.29**	–.40**	–.23**
17. Novelty frust.	1–5	2.57	.90								–.53**	–.46**	–.36**
18. Vitality	1–7	5.07	1.26									.64**	.56**
19. Life satisfaction	1–5	3.74	.83										.54**
20. Meaning	1–7	4.76	1.14										

p* < .05; *p* < .01

^aGender coded as 1 = Male, 2 = Female

^bSocioeconomic status coded as 1 = Low, 2 = Medium, 3 = High

^cEducation level coded as 1 = Non completed primary education, 2 = Completed primary education, 3 = Completed secondary school education, 4 = University degree

Imp. = Importance; Sat. = Satisfaction; Frust. = Frustration

Descriptive statistics and correlations among study variables are shown in Table 2. Novelty satisfaction and frustration constructs were associated with outcomes in a similar way that the three basic psychological needs satisfaction and frustration constructs.

Regression analysis

The regression analysis showed that the composite scores of satisfaction and frustration made a differential contribution to the explanation of well-being, such that need satisfaction positively predicted well-being outcomes, while need frustration negatively predicted well-being outcomes with the exception of meaning. Therefore, we examined the relative contribution of need satisfaction and frustration in separate analyses.

Results of the linear multiple regression analyses are presented in Table 3. After controlling for sociodemographic variables, results indicated that the three well-being outcomes (vitality, life satisfaction, and meaning) were positively predicted by satisfaction of the three basic psychological needs and need for novelty. The only exception was the effect of relatedness need satisfaction on vitality, which was not statistically significant. Competence and novelty frustration negatively predicted all three well-being outcomes. Life satisfaction was also negatively predicted by relatedness frustration, and presence of meaning in life by autonomy frustration.

The moderation analysis (Appendix 3, see Table 5) showed that the relations between need satisfaction and frustration and well-being were not moderated by the importance assigned to each need. Three interaction terms (for competence satisfaction \times competence importance and novelty frustration \times novelty importance on vitality, and for novelty satisfaction \times novelty importance on meaning) obtained a p value below .05, but all the p values were higher than their corresponding Benjamini–Hochberg critical values and so were considered non-significant. Nevertheless, openness to experience moderated not only the relations between novelty satisfaction and the different well-being indicators, but also the relations between the three basic psychological needs satisfaction constructs and these indices of well-being. Simple slope tests showed that these relations were significant at the different values of the moderator. Specifically, openness to experience strengthened the positive relations between the need satisfaction constructs and vitality, life satisfaction, and meaning. Interaction plots showed higher values of vitality when need satisfaction and openness to experience were high; lower values of life satisfaction when need satisfaction was low and openness to experience was high; higher values of meaning when need satisfaction and openness to experience were high; and lower values of meaning when need satisfaction was low and openness to experience was high (see at <https://osf.io/jwx57/>).

Regarding the moderating role of openness to experience on the relations between need frustration and well-being, the pattern

of results was not so clear. The regression coefficients of the interaction terms for competence frustration, relatedness frustration, and novelty frustration on vitality, as well as the interaction terms for relatedness frustration on life satisfaction and meaning, were significant (Appendix 3, see Table 5). Simple slope tests revealed that these relations were significant at the different levels of the moderator. Openness to experience strengthened the negative relations between these need frustration constructs and these indices of well-being. Interaction plots showed higher values of vitality when need frustration was low and openness to experience was high; and higher values of life satisfaction and meaning when relatedness frustration was low and openness to experience was high (see at <https://osf.io/jwx57/>).

Discussion

Confirming our first hypothesis, this study showed that novelty satisfaction was positively associated, and novelty frustration negatively associated, with vitality, life satisfaction, and the presence of meaning in life, beyond the three existing needs. Current results indicate that the need for novelty would fulfill Ryan and Deci's (2017) first criterion for inclusion of a candidate need as a basic need in BPNT. The criterion suggests that satisfaction of the need should be positively related to outcomes linked to optimal functioning, and frustration of the need should be related to maladaptive functioning. Items developed to assess novelty frustration in the present study exhibited adequate psychometric properties, and its use within the BPNSFS (Chen et al. 2015) seems appropriate.

Regarding our second hypothesis, associations between needs and well-being were not moderated by need importance. These results are consistent with Study 1 and Chen et al.'s (2015) findings, which showed that need valuation/desire did not moderate relations between need satisfaction/frustration and self-esteem, depressive symptoms, vitality, and life satisfaction. Nevertheless, contrary to our second hypothesis, openness to experience moderated effects of novelty need satisfaction and frustration on well-being, although the same moderation effects were found for the three basic psychological needs. Specifically, openness to experience strengthened these relations showing that high openness to experience and high need satisfaction/low need frustration leads to higher levels of adaptive outcomes. These results reflect an interaction between personality and need satisfaction that could be an interesting avenue for future research.

According to our results, the need for novelty did not completely fulfill Ryan and Deci's sixth inclusion criterion, which states that effects of basic psychological needs satisfaction/frustration should be independent of whether or not people value these needs (Ryan and Deci 2017). However, novelty satisfaction/frustration showed a very similar functioning to the three basic psychological needs in this study.

Table 3 Results of multiple regression analyses in which vitality, life satisfaction, and meaning outcomes were regressed on need satisfaction and frustration constructs

	Vitality				
	<i>B</i> (95% CI)	<i>SEB</i>	β	<i>t</i>	<i>R</i> ²
	1.00 (.21, 1.78)	.40		2.49	.49
Gender	-.18 (-.33, -.03)	.08	-.07*	-2.42	
Age	-.01 (-.01, .01)	.01	-.01	-.26	
Socioeconomic	.06 (-.13, .25)	.10	.02	.65	
Education	-.18 (-.30, -.06)	.06	-.10**	-3.00	
Autonomy satisfaction	.48 (.35, .61)	.07	.30***	7.21	
Competence satisfaction	.34 (.20, .48)	.07	.19***	4.70	
Relatedness satisfaction	-.01 (-.13, .13)	.06	-.01	-.02	
Novelty satisfaction	.50 (.39, .61)	.06	.33***	8.83	
	8.10 (7.34, 8.85)	.39		21.04	.37
Gender	-.13 (-.29, .04)	.08	-.05	-1.50	
Age	-.01 (-.01, .01)	.01	-.05	-1.28	
Socioeconomic	.12 (-.09, .33)	.11	.04	1.14	
Education	-.19 (-.32, -.06)	.07	-.10**	-2.85	
Autonomy frustration	-.07 (-.20, .06)	.07	-.05	-1.08	
Competence frustration	-.49 (-.61, -.36)	.07	-.34***	-7.53	
Relatedness frustration	.11 (-.03, .25)	.07	.06	1.55	
Novelty frustration	-.46 (-.59, -.33)	.07	-.33***	-6.86	
	Life satisfaction				
	<i>B</i> (95% CI)	<i>SEB</i>	β	<i>t</i>	<i>R</i> ²
	-.27 (-.80, .27)	.27		-.97	.45
Gender	.04 (-.06, .14)	.05	.02	.74	
Age	.01 (-.01, .01)	.01	.02	.62	
Socioeconomic	.24 (.11, .37)	.07	.12***	3.68	
Education	.06 (-.02, .14)	.04	.05	1.40	
Autonomy satisfaction	.42 (.33, .51)	.05	.39***	9.24	
Competence satisfaction	.12 (.02, .21)	.05	.10*	2.32	
Relatedness satisfaction	.17 (.08, .26)	.04	.14***	3.83	
Novelty satisfaction	.14 (.06, .21)	.04	.14***	3.59	
	4.50 (3.98, 5.00)	.26		17.36	.34
Gender	.09 (-.03, .20)	.06	.05	1.50	
Age	-.01 (-.01, .01)	.01	-.01	-.35	
Socioeconomic	.24 (.10, .38)	.07	.12**	3.38	
Education	.03 (-.06, .12)	.04	.03	.70	
Autonomy frustration	-.07 (-.15, .02)	.05	-.07	-1.44	
Competence frustration	-.30 (-.39, -.22)	.04	-.32***	-6.98	
Relatedness frustration	-.11 (-.20, -.01)	.05	-.10*	-2.23	
Novelty frustration	-.16 (-.25, -.08)	.05	-.18***	-3.65	
	Meaning				
	<i>B</i> (95% CI)	<i>SEB</i>	β	<i>t</i>	<i>R</i> ²
	.72 (-.10, 1.54)	.42		1.73	.32
Gender	.01 (-.15, .16)	.08	.01	.07	
Age	.01 (.01, .02)	.01	.14***	3.76	
Socioeconomic	-.05 (-.25, .14)	.10	-.02	-.53	

Table 3 (continued)

	Meaning					R^2
	B (95% CI)	SEB	β	t		
Education	-.07 (-.19, .05)	.06	-.04	-1.15		
Autonomy satisfaction	.41 (.28, .55)	.07	.28***	6.00		
Competence satisfaction	.22 (.07, .37)	.08	.13**	2.86		
Relatedness satisfaction	.15 (.02, .28)	.07	.09*	2.20		
Novelty satisfaction	.24 (.13, .36)	.06	.18***	4.09		
	6.13 (5.35, 6.90)	.39		15.57		.20
Gender	.03 (-.14, .20)	.09	.01	.31		
Age	.01 (.01, .02)	.01	.12**	2.97		
Socioeconomic	.01 (-.21, .22)	.11	.01	.05		
Education	-.08 (-.22, .05)	.07	-.05	-1.23		
Autonomy frustration	-.17 (-.30, -.03)	.07	-.13*	-2.43		
Competence frustration	-.26 (-.39, -.13)	.07	-.20***	-3.90		
Relatedness frustration	-.04 (-.18, .11)	.07	-.03	-.52		
Novelty frustration	-.20 (-.33, -.06)	.07	-.16**	-2.88		

* $p < .05$; ** $p < .01$; *** $p < .001$

General discussion

The purpose of this research was to test novelty as a candidate basic psychological need within BPNT, and providing further evidence that it fulfills key inclusion criteria for psychological needs proposed by Ryan and Deci (2017). Two studies aimed to address whether the need for novelty met specific inclusion criteria in general life and in a specific behavioral context (exercise), and extend preliminary data on this need (González-Cutre and Sicilia 2019; González-Cutre et al. 2016). Our results present further initial support for the role of novelty as a basic psychological need, and provide a firm basis to continue this line of research that seeks to expand the role of need satisfaction and frustration in BPNT.

Our first aim was to replicate and extend previous analyses supporting the inclusion of the need for novelty in BPNT, consistent with Ryan and Deci's (2017) first inclusion criterion. Regarding the results in the exercise context in Study 1, satisfaction of the need for novelty positively and directly predicted autonomous motivation and vitality. It also indirectly predicted enjoyment and vitality through autonomous motivation. These results showed the 'bright side' of the need for novelty according to this first inclusion criterion, and were consistent with previous findings for the three basic psychological needs in exercise settings (Moreno et al. 2008c; Vlachopoulos and Karageorghis 2005; Wilson et al. 2006). Moreover, these results supported the role of motivation as a mediator of the relation between novelty need satisfaction and outcomes, consistent with our second aim and Ryan and Deci's third inclusion criterion. Nevertheless, without measures of social factors (e.g., autonomous and controlling interpersonal

styles), we could not analyze the mediating effect of novelty need satisfaction/frustration on relations between social factors, motivation, and outcomes. This is a limitation of the current study and is an avenue for future research.

In Study 2, results also revealed that satisfaction of the need for novelty was positively related to adaptive outcomes and optimal functioning in general life (vitality, life satisfaction, meaning in life), and its frustration was negatively related to these outcomes ('dark side'). These results are in line with Birdsell's (2018) study in Japanese university students in an English learning context, and reinforces that the pattern of effects for novelty need satisfaction and frustration on well-being is consistent with those proposed by Ryan and Deci (2017) in their first inclusion criterion. However, our study did not include measures of ill-being, a limitation that should be addressed in future research. Previous research has shown that positive associations between need frustration and ill-being are larger than the negative associations between need frustration and well-being (Ryan and Deci 2017). Future studies should examine the relations between novelty frustration and ill-being outcomes such as burnout, exhaustion, or negative affect to corroborate this pattern of effects for the need for novelty.

Considering our third aim, we tested whether importance assigned to novelty, and openness to experience, moderated the relations between this candidate need, motivation, and indices of well-being in Study 1 and 2. Results demonstrated that novelty importance did not act as a moderator, but openness to experience moderated relations between novelty need satisfaction and frustration and well-being indices, such that these relations were stronger when openness to experience was higher. However, novelty need satisfaction was positively related, and novelty

need frustration negatively related, to well-being even when the openness to experience was low. Interestingly a similar pattern of effects was found for the three basic psychological needs.

In this vein, a recent trend in research on BPNT advocates a more moderate perspective on the universality of needs, considering that personal characteristics could play a moderating role on the effect of need satisfaction and frustration on well-being (Van Assche et al. 2018). Consistent with this perspective, several studies have shown that personality variables could moderate relations between social factors, need satisfaction/frustration, and outcomes, although effect sizes were modest (Schüler et al. 2013; Mabbe et al. 2016, 2018; Van Assche et al. 2018). This moderate viewpoint of universalism is consistent with the moderating effects of openness to experience on the relations between need satisfaction/frustration and well-being. Future studies should seek to test the universality of both the basic needs and the need for novelty across diverse behaviors, contexts, and populations with the objective of replicating these effects and providing consistent evidence to test whether basic psychological needs fulfill Ryan and Deci's (2017) sixth inclusion criterion, or we should adopt a more moderate viewpoint of universalism.

In conclusion, the present research complements previous studies that have tested the need for novelty as an additional candidate need within BPNT (González-Cutre and Sicilia 2019; González-Cutre et al. 2016), providing support for inclusion criteria that had not been tested until now. Although current results partially supported our initial hypotheses, we should exercise caution in generalizing these results broadly and making definitive statements that novelty should be considered a basic psychological need. Our results should serve as a catalyst for future research, replicating and extending current results to further verify the role of novelty as a basic need within BPNT.

In addition, longitudinal studies that examine the variations in novelty need satisfaction and frustration over time and how they relate to indices of well-being, optimal functioning, and maladaptive consequences are needed. In this regard, variation in novelty as a daily need should be examined (Reis et al. 2000). It would also be interesting to investigate whether the experience of novelty and basic psychological need satisfaction during satisfying events is associated with life satisfaction, flourishing, growth, and well-being in the middle and long term. Moreover, intervention studies are essential to verify whether strategies and techniques aimed at enhancing novelty need satisfaction achieve actual changes in the satisfaction of this need with concomitant effects on salient outcomes. Future studies should analyze whether an "excess" of novel stimuli is all that is necessary to lead to satisfaction of the need for novelty, or whether novelty satisfaction is only achieved when novel stimuli are interpreted as need satisfying, in conjunction with the satisfaction of the other BPNT needs.

Future research should also explore whether people are able to readily distinguish between novelty and variety, and view

them as distinct constructs. Although the literature establishes conceptual differences between novelty and variety (e.g., Sylvester et al. 2018), there is likely to be some overlap in the items used to measure novelty frustration and measures of variety.

It would also be interesting to analyze the role of novelty in Ryan and Deci's (2017) proposition that meaningful exposure to living nature has a positive effect on subjective vitality, and this relation is mediated in part by basic psychological needs. Novelty has been identified as a primary element in hiking, adventure and nature-based tourism (Lee et al. 2018), and, therefore, it could mediate the effect of nature on vitality.

Ultimately, future research will be informative as to whether novelty could become one of "the four legs of the table" that sustain motivation and well-being, along with the three basic psychological needs. On this matter, it is probable that the recent approach to the study of motivation from neuroscience (Di Domenico and Ryan 2017; Kidd and Hayden 2015; Reeve and Lee 2019) could be important to determine the function of need for novelty in BPNT.

Funding The contribution of Martin S. Hagger was supported by a Finland Distinguished Professor (FiDiPro) award (Dnro 1801/31/2105) from Business Finland, the Finnish funding agency for innovation.

Compliance with ethical standards

Conflict of interest All the authors declared that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

Appendix 1

Participants in Study 1 were asked for the explicit importance assigned to each of the basic psychological needs and the need for novelty in their life, and they also were asked to rate the satisfaction of these needs with respect to a recent satisfying event in their life (Sheldon et al. 2001). The question about satisfying events was an indirect means to measure participants' need importance. It was formulated to take into account that basic psychological needs seem to be related to optimal development regardless of how conscious people are of its importance (Chen et al. 2015). People may not explicitly regard novelty as an important need in general life contexts, but it may still contribute to their actions toward specific satisfying events beyond their conscious awareness. Therefore, considering that satisfying events play a unique function in the pursuit of happiness and meaning in life (Fritz et al. 2017;

Young et al. 2018), satisfaction of the need for novelty may be associated to positive functioning (Ryan and Deci 2017). We hypothesized that novelty satisfaction would score highly in relation to satisfying events, although people considered this need less important than the three basic psychological needs. This hypothesis would represent an exploratory approach to the sixth inclusion criterion, since satisfaction of novelty would be evidenced regardless of whether or not people explicitly valued this need.

Measures

Need satisfaction in a satisfying life event

We employed the same instrument described to measure need importance in general life but modified the instructions to refer to a recent satisfying life event. Participants were asked to recall and write a brief paragraph on a recent satisfying experience prior to completing the scales. Items were formulated in past tense and preceded by the common stem “During that experience I felt that...”.

Data analysis

To analyze the importance of autonomy, competence, relatedness, and novelty in participants’ lives, we conducted a descriptive analysis of the scores obtained both directly (importance assigned in general life) and indirectly (need satisfaction in a satisfying life event). Significant differences between mean scores of each need were calculated using paired samples *t*-tests. The Benjamini–Hochberg procedure (Benjamini and Hochberg 1995) with a false discovery rate of .05 was used in this analysis to reduce the number of false positives due to multiple comparisons.

Descriptive analysis of the basic psychological needs and the need for novelty in life

Variables	Importance in general life			Satisfying event		
	<i>M</i>	<i>SD</i>	α	<i>M</i>	<i>SD</i>	α
Autonomy	6.65	.58	.77	6.00	1.04	.73
Competence	6.24	.79	.77	5.60	1.01	.62
Relatedness	6.12	.77	.75	6.00	.91	.81
Novelty	6.05	.95	.92	6.14	1.06	.89

We show descriptive data about the importance participants assigned to the basic psychological needs and the need for novelty in general life, and their satisfaction in a specific satisfying life event. Regarding the importance in general life all needs obtained high values according to the scales used. Taking into account the Benjamini–Hochberg critical value, autonomy was the need obtaining the highest mean score and was significantly different from competence ($t = 10.11$, $df = 302$, $p < .001$, $d = 1.16$), relatedness ($t = 12.65$, $df = 302$, $p < .001$, $d = 1.45$) and novelty ($t = 13.24$, $df = 302$, $p < .001$, $d = 1.52$). Competence also obtained a higher score than relatedness ($t = 2.65$, $df = 302$, $p = .008$, $d = 0.30$) and novelty ($t = 5.08$, $df = 302$, $p < .001$, $d = 0.58$). In relation to the specific satisfying life event, the satisfaction of the need for novelty obtained the highest score, which was significantly different from competence ($t = 9.58$, $df = 302$, $p < .001$, $d = 1.10$) and relatedness ($t = 2.27$, $df = 302$, $p = .023$, $d = 0.26$). The *p* value for the difference between novelty satisfaction and autonomy satisfaction in the satisfying life event ($t = 1.98$, $df = 302$, $p = .048$, $d = 0.23$) was marginally higher than the Benjamini–Hochberg critical value (.042) and, therefore, this difference was considered not significant.

Discussion

The need for novelty obtained the lowest score when people were asked to assign importance to the three basic psychological needs and the need for novelty in their lives, although it should be noted that all needs obtained high values. However, when participants were asked about the degree of satisfaction of these needs in a specific satisfying life event, novelty obtained the highest score. Therefore, although participants considered novelty as the least important of these needs, results showed that novelty need satisfaction seemed to play a significant role in satisfying life events that lead to well-being, such as finishing a university degree, getting a job, leaving their parents’ home, getting married, experiencing the birth of a child or grandchild, traveling to a desired place, or achieving sport challenges. Based on these results, novelty satisfaction could be important for human development regardless of the importance assigned to this need.

Appendix 2

See Table 4.

Table 4 Results of moderated regression analysis for the interactive effects of each need satisfaction construct with need importance on motivation, enjoyment, and vitality in the exercise context

	Autonomous motivation				Controlled motivation				Amotivation				
	<i>B</i> (95% CI)	<i>p</i>	Rank	<i>B-H</i>	<i>B</i> (95% CI)	<i>p</i>	Rank	<i>B-H</i>	<i>B</i> (95% CI)	<i>p</i>	Rank	<i>B-H</i>	
Autonomy satisfaction × Autonomy importance	-.03 (-.11, .05)	.506	3	.0375	.01 (-.11, .11)	.01	.986	4	.05	-.03 (-.14, .08)	-.03	.635	3
Competence satisfaction × Competence importance	-.06 (-.13, .01)	.106	2	.025	.14 (.04, .23)	.16	.007	1	.0125	.12 (.02, .21)	.14	.018	2
Relatedness satisfaction × Relatedness importance	.01 (-.07, .08)	.909	4	.05	-.01 (-.10, .09)	-.01	.905	3	.0375	.01 (-.08, .11)	.01	.801	4
Novelty satisfaction × Novelty importance	-.09 (-.17, -.02)	.017	1	.0125	.07 (-.04, .17)	.07	.218	2	.025	.13 (.03, .23)	.14	.015	1

	Enjoyment				Vitality			
	<i>B</i> (95% CI)	<i>p</i>	Rank	<i>B-H</i>	<i>B</i> (95% CI)	<i>p</i>	Rank	<i>B-H</i>
Autonomy satisfaction × Autonomy importance	-.04 (-.14, .07)	.499	2	.025	-.05 (-.13, .03)	-.06	1	.189
Competence satisfaction × Competence importance	.01 (-.08, .10)	.831	3	.0375	-.03 (-.10, .04)	-.04	2	.335
Relatedness satisfaction × Relatedness importance	-.01 (-.09, .09)	.943	4	.05	-.03 (-.10, .05)	-.03	3	.475
Novelty satisfaction × Novelty importance	.04 (-.06, .14)	.405	1	.0125	-.01 (-.08, .07)	-.01	4	.837

Rank rank of *p* values for each group of tests, *B-H* Benjamini–Hochberg critical value

Appendix 3

See Table 5.

Table 5 Results of moderated regression analysis for the interactive effects of each need satisfaction and frustration construct with need importance and openness to experience on vitality, life satisfaction, and meaning in the general life context

	Vitality					Life satisfaction					Meaning				
	<i>B</i> (95% CI)	β	<i>p</i>	Rank	B-H	<i>B</i> (95% CI)	β	<i>p</i>	Rank	B-H	<i>B</i> (95% CI)	β	<i>p</i>	Rank	B-H
	Autonomy satisfaction × Autonomy importance	-.05 (- .10, .01)	-.06	.082	3	.01875	-.02 (- .08, .03)	-.03	.432	4	.025	.01 (- .06, .07)	.01	.891	7
Competence satisfaction × Competence importance	-.05 (- .09, -.01)	-.08	.025	1	.00625	-.03 (- .07, .02)	-.04	.241	2	.0125	.02 (- .03, .08)	.04	.363	3	.01875
Relatedness satisfaction × Relatedness importance	.01 (- .04, .06)	.01	.683	6	.0375	-.02 (- .07, .03)	-.03	.497	5	.03125	.02 (- .04, .07)	.02	.607	4	.025
Novelty satisfaction × Novelty importance	.04 (- .02, .09)	.04	.169	4	.025	-.01 (- .07, .04)	-.02	.647	7	.04375	.06 (.01, .12)	.08	.039	1	.00625
Autonomy frustration × Autonomy importance	-.01 (- .06, .04)	-.01	.726	7	.04375	.01 (- .04, .07)	.02	.627	6	.0375	-.01 (- .07, .05)	-.02	.695	6	.0375
Competence frustration × Competence importance	.01 (- .05, .06)	.01	.861	8	.05	.03 (- .03, .09)	.03	.347	3	.01875	-.02 (- .08, .05)	-.02	.634	5	.03125
Relatedness frustration × Relatedness importance	.04 (- .02, .09)	.05	.203	5	.03125	.05 (- .01, .11)	.06	.075	1	.00625	-.01 (- .07, .06)	-.01	.906	8	.05
Novelty frustration × Novelty importance	-.05 (- .11, -.01)	-.06	.047	2	.0125	.01 (- .05, .06)	.01	.810	8	.05	-.04 (- .10, .02)	-.05	.197	2	.0125
Autonomy satisfaction × Openness to experience	.08 (.03, .13)	.10	.003	5	.03125	.09 (.04, .14)	.11	.001	3	.01875	.09 (.04, .15)	.12	.002	4	.025
Competence satisfaction × Openness to experience	.14 (.10, .18)	.22	<.001	1	.00625	.10 (.06, .14)	.16	<.001	1	.00625	.11 (.06, .15)	.17	<.001	1	.00625
Relatedness satisfaction × Openness to experience	.10 (.06, .15)	.15	<.001	2	.0125	.10 (.05, .14)	.14	<.001	2	.0125	.11 (.06, .16)	.16	<.001	2	.0125
Novelty satisfaction × Openness to experience	.09 (.04, .14)	.11	.001	4	.025	.06 (.01, .11)	.08	.020	5	.03125	.08 (.02, .14)	.10	.006	5	.03125
Autonomy frustration × Openness to experience	-.03 (- .08, .02)	-.03	.289	8	.05	-.02 (- .07, .04)	-.02	.577	8	.05	-.04 (- .10, .02)	-.05	.207	8	.05
Competence frustration × Openness to experience	-.08 (- .13, -.02)	-.09	.005	6	.0375	-.05 (- .11, .01)	-.06	.078	7	.04375	-.05 (- .11, .01)	-.06	.104	6	.0375
Relatedness frustration × Openness to experience	-.10 (- .14, -.05)	-.13	<.001	3	.01875	-.07 (- .12, -.02)	-.09	.008	4	.025	-.10 (- .15, -.05)	-.14	<.001	3	.01875
Novelty frustration × Openness to experience	-.06 (- .11, -.01)	-.08	.018	7	.04375	-.05 (- .11, .01)	-.07	.051	6	.0375	-.05 (- .11, .01)	-.06	.132	7	.04375

Rank rank of *p* values for each group of tests, *B-H* Benjamini-Hochberg critical value

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