Current Psychology (2022) 41:2998–3012
https://doi.org/10.1007/s12144-020-00828-8

Refining the assessment of need supportive and need thwarting interpersonal behaviors using the bifactor exploratory structural equation modeling framework

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Published online: 2 June 2020

Abstract

The present research assessed the psychometric multidimensionality and criterion-related validity the Interpersonal Behaviours Questionnaire using the bifactor-exploratory structural equation modeling framework. Study 1 relied on a sample of 772 participants, and supported the superiority of a bifactor-ESEM representation compared to alternative representations. Ratings of need supportive and thwarting behaviors simultaneously reflected a global overarching need nurturing behaviors construct (rather than two separate need supportive and need thwarting behaviors), which co-existed with six specific dimensions (autonomy, competence, and relatedness need supportive and thwarting behaviors). These results were replicated in a second independent sample of 742 participants and across gender. Our findings supported the criterion-related validity of interpersonal behaviors in relation to positive affect, negative affect, and need fulfillment across samples and genders. We finally discuss the theoretical and practical implications of relying on the bifactor-ESEM framework when investigating need supportive and thwarting interpersonal behaviors.

Keywords Bifactor · Exploratory structural equation modeling (ESEM) · Interpersonal Behaviours questionnaire (IBQ) · Need support and thwarting · Self-determination theory (SDT)

The satisfaction and frustration of individuals' basic psychological needs are important drivers of motivation, performance, and psychological functioning across various spheres of life (Ryan and Deci 2017). Self-determination theory (SDT; Deci and Ryan 2000) posits that the satisfaction of the needs for autonomy (i.e., experiencing that one's actions are the result of volition and choice), competence (i.e., experiencing efficiency and mastery when interacting with the environment), and relatedness (i.e., feeling a sense of social belonging with others) is a core driver of self-determined goal-directed behaviors. In contrast, the frustration of these needs leads to negative outcomes such as ill-being and distress (Bartholomew et al. 2011b; Vansteenkiste and Ryan 2013). To understand how these needs can be satisfied or frustrated among individuals, one needs to consider the need supportive and thwarting characteristics of the environment (Ryan and Deci 2017).

Despite the recognition that a complete assessment of need supportive and need thwarting behaviors should tap into the three needs for autonomy, competence, and relatedness (Rocchi et al. 2017a; Rocchi et al. 2017b), research has never formally tested whether these behaviors are perceived in a more holistic manner as one (global need nurturing behaviors) or two (global need support and thwarting behaviors) overarching dimension(s). This global approach is supported by the observation of high positive correlations among ratings of autonomy, competence, and relatedness need supportive (e.g., Rocchi et al. 2017a, 2017b) and need thwarting (e.g., Myers et al. 2014; Rocchi et al. 2017a, 2017b) behaviors, as well as

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s12144-020-00828-8) contains supplementary material, which is available to authorized users.

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of moderately high negative correlations among ratings of need supportive and thwarting behaviors (Rocchi et al. 2017a, 2017b). Past research has also supported the presence of one global dimension underlying ratings of autonomy, competence, and relatedness need thwarting or need supportive behaviors in the sport area (Myers et al. 2014; Stenling et al. 2015). However, research also reveals differentiated relations between external criteria and these six behavioral dimensions (autonomy, competence, and relatedness supportive and thwarting behaviors) (Rocchi et al. 2017a, 2017b).

More specifically, these observations raise important questions related to: (a) whether need supportive and need thwarting behaviors are better represented by one (i.e., need nurturing behaviors) or two (i.e., separate need support and need thwarting dimensions) global dimension(s); (b) whether specific need supportive and need thwarting behaviors retain specificity beyond the assessment of these overarching constructs; and (c) whether these overarching constructs exist as global entities including specificities mapped by the six behavioral dimensions, or whether these behaviors reflect distinct, yet correlated dimensions without a common core (Morin et al. 2016b; 2017). The present study was specifically designed to address these questions while focusing on participants' responses to the recently developed Interpersonal Behaviours Questionnaire (IBQ), a questionnaire specifically developed to assess autonomy, relatedness, and competence need supportive and thwarting behaviors across various domains (Rocchi et al. 2017a, 2017b; Rodrigues et al. 2019).

Construct-Relevant Psychometric Multidimensionality

Morin and colleagues (Morin et al. 2016a; Morin et al. 2016b; 2017) note that construct-relevant psychometric multidimensionality needs to be specifically modelled when conceptually-related constructs are assessed within an instrument, as is the case for measures of such as competence, autonomy, and relatedness supportive and thwarting behaviors. Construct-relevant psychometric multidimensionality refers to the idea that item ratings might be reliably associated with more than one latent construct. When ignored in confirmatory factor analysis (CFA), these additional associations have been shown to result in biased structural parameter estimates (Asparouhov et al. 2015; Mai et al. 2018; Morin et al. 2016a).

Coexisting Global and Specific Constructs A first form of construct-relevant psychometric multidimensionality that is relevant to the measure of need supportive and thwarting behaviors is related to the simultaneous assessment of global and specific constructs. When considering whether need supportive and need thwarting interpersonal behaviors are best represented as global constructs (Bartholomew et al. 2011a; Myers et al. 2014) or as conceptually-distinct constructs (Rocchi et al. 2017a, 2017b), a third option exists according to which interpersonal behaviors might exist as one or two global entities reflecting commonalities among ratings of autonomy, competence, and relatedness supportive and thwarting behaviors, which themselves may include specificity unexplained by these global entities (S-factors). In the sport area, results tentatively support the idea that ratings of autonomy, competence, and relatedness supportive behaviors are conceptually-related dimensions of a global need supportive behaviors construct, and that ratings of autonomy, competence, and relatedness thwarting similarly can be taken to reflect a global need thwarting behaviors construct (Myers et al. 2014; Pulido et al. 2018; Stenling et al. 2015). However, questions remain as to whether sufficient specificity exists in the three behavioral dimensions once the global construct is accounted for, and whether one or two global constructs are required to reflect the full spectrum of need supportive and thwarting behaviors. Higher-order factor models and bifactor models can both be used to achieve a proper disaggregation of this global/specific nature of need supportive and thwarting behaviors. However, the greater flexibility of bifactor models, which rely on the estimation of direct relations between the latent factors and item ratings, has led to recent recommendations of their superiority (Morin et al. 2016a; Reise 2012).

Conceptually-Related Constructs A second form of construct-relevant psychometric multidimensionality that is relevant to the measure of need supportive and thwarting behaviors emerges from the imperfect nature of items which typically are found to be partially associated with non-target constructs (Morin et al. 2016a). This type of multidimensionality is best taken into account via exploratory factor analyses (EFA), in which cross-loadings are allowed between items and non-target constructs. The newly developed exploratory structural equation modeling (ESEM; Marsh et al. 2014) framework represents the combination of EFA, CFA and structural equation modeling, providing a way to account for this type of multidimensionality across a broader range of models, including bifactor representations (Morin et al. 2016a). Interestingly, the recent study of Bhavsar et al. (2019) supported the added value of ESEM with respect to athletes' perceptions of their coaches' interpersonal behaviors.

Current Research Evidence for Multidimensionality Research centered on need supporting and thwarting behaviors is scarcer outside of Rocchi et al.'s (2017a, 2017b) validation studies. When we look at research evidence related to ratings of need supportive and thwarting behaviors, Myers et al. (2014) first showed that the structure of athletes' ratings of the need thwarting behaviors present in their sport followed a bifactor-ESEM representation including an overarching need

thwarting G-factor co-existing with well-defined S-factors related to the specific needs for autonomy competence, and relatedness (behavioral imbalance). These results have been replicated by Stenling et al. (2015). To our knowledge, only Pulido et al. (2018) examined the representation of coaches' interpersonal styles using a measure combining need supportive and thwarting behaviors. Although these authors found support for a hierarchical-ESEM structure including two higher-order factors, they failed to consider the more realistic bifactor-ESEM alternative and whether a single global factor could have been sufficient in capturing the globality of need nurturing behaviors, a possibility reinforced by their report of a high negative correlation between the global need supportive and thwarting factors ($r = -.673$).

To our knowledge, this possibility has never been investigated specifically for combined measures of need supportive and thwarting behaviors, and never been investigated outside of the sport area. Still, one study systematically considered this possibility when considering participants' ratings of the satisfaction and frustration of their basic psychological needs in their life in general. In this study, Tóth-Király et al. (2018) investigated the underlying structure of responses provided to the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al. 2015). Their results supported a global "need fulfillment" representation, incorporating a single G-factor, reflecting participants' global levels of need fulfillment, co-existing with six S-factors reflecting the degree to which participants felt imbalance in the degree to which each of their specific need was either satisfied or frustrated beyond their global levels of need satisfaction. Models with two global factors (global need satisfaction and frustration) resulted in overlapping factors, and were not supported by the data.

Criterion-Related Validity

Despite the interest of these pioneering studies on the structure of need supportive and thwarting behaviors, only Pulido et al. (2018) reported any evidence for the criterion-related validity for the bifactor solution. Their results generally supported the criterion-related validity of the global need supporting and thwarting factors and participants' ratings of their levels of need satisfaction and frustration. Unfortunately, they did not report information regarding the relations involving the specific autonomy, competence, and relatedness need thwarting behaviors leaving as an open question whether the specificity associated with these dimensions, contributes to the prediction of need satisfaction/frustration over and above that afforded by the global factors.

Likewise, despite the fact that Rocchi et al. (2017a, 2017b) as well as Bhavsar et al. (2020) demonstrated the criterion-related validity of the IBQ in relation to need satisfaction and frustration, wellbeing, and motivation, these studies failed to disaggregate the variance explained by participants' global perceptions before looking at the specific role of autonomy, competence, and relatedness. The reliance on a bifactor-ESEM representation of need supportive/thwarting behaviors and of need satisfaction/frustration would make it possible to achieve a much cleaner disaggregation of the effects occurring at the global versus specific (behavioral imbalance) level. Importantly, this approach provides a way to take into account Sheldon and Niemiec's (2006; also see Dysvik et al. 2013) proposal that a complete understanding of psychological needs requires the simultaneous consideration of each need taken separately, but also of the degree to which they are aligned with one another, or the presence of imbalance in the degree to which all three needs are met.

The present study seeks to establish the criterion-related validity of participants' perceptions of the need supportive and need thwarting behaviors of people in their environment in relation to ratings of need satisfaction, need frustration, positive affect, and negative affect (Gillet et al. 2012; Ryan and Deci 2017). Based on previous studies, we expected that global levels of need nurturing behaviors would be negatively associated with negative affect and need frustration, and positively associated with positive affect and need satisfaction. Over and above the effects of the global levels of need nurturing/supportive/thwarting behaviors, we also hypothesize that specific levels of autonomy, competence, and relatedness supportive and thwarting behaviors will present direct relations with the outcomes. However, lacking prior guidance, we leave as an open question whether these specific relations would reflect the incremental value of these behaviors (e.g., Sánchez-Oliva et al. 2017), or whether they will reflect need nurturing imbalance (e.g., Dysvik et al. 2013; Sheldon and Niemiec 2006).

The Present Research

In the present research, we rely on the bifactor-ESEM (e.g., Morin et al. 2016b; 2017) framework to assess the underlying measurement structure of participants' ratings of the need supportive and thwarting behaviors of people in their environment. Following from Rocchi et al. (2017a, 2017b) and Tóth-Király et al. (2018), we also investigate the extent to which the optimal measurement structure of the IBQ would generalize across two distinct samples of participants, but also across genders. In addition, to examine whether there is value in considering specific levels of imbalance in the level of need supportive and thwarting behaviors over and above global levels of need nurturing/supportive/thwarting behaviors, we assess the criterion-related validity of these global and specific ratings in relation to various outcomes.

Methods

Procedure and Participants

Study 1 A total of 772 Hungarian participants (64.4% female) with a mean age of 27.94 years ($SD = 9.64$) participated in this study. They reported their highest level of education as primary (6.9%), secondary (64.9%), and higher (28.1%), and their place of residence as the capital city (42.9%), county capitals (13.9%), cities (27.2%), and country (16.1%). Participants were recruited between July 2017 and October 2017 via a number of mailing lists, online forums, and websites in order to gather a relatively large and diversified community sample of participants, in order to maximize the generalizability of our results. Before completing the questionnaires electronically, they were informed about the conditions of participation and had to explicitly indicate their consent. The study was conducted with the approval of the University Research Ethics Committee and in line with the Declaration of Helsinki.

Study 2 In the light of the recent replication crisis plaguing the different fields of psychology (e.g., Pashler and Wagenmakers 2012) and to test the potential generalizability of the results, a second sample of 742 Hungarian participants (80.9% female) with a mean age of 26.49 years ($SD = 7.27$) participated in this study. These participants reported their highest level of education as primary (0.9%), secondary (59.1%), and higher (40%), and their place of residence as the capital city (46%), county capitals (15.6%), cities (26.3%), and country (12.1%). This study followed the same procedures as Study 1 and participants completed the same set of questionnaires between November 2017 and February 2018.

Measures

Interpersonal Behaviours Questionnaire (IBQ) Participants completed the 24-item IBQ (Rocchi et al. 2017a). A context-general stem was used (i.e., "The people in my life…") and followed by the 24 items assessing the six following dimensions with 4 items each: autonomy support (e.g., "…support my decisions" ; $\alpha = .882$) and thwarting (e.g., "…impose their opinions on me"; $\alpha = .885$), competence supportive (e.g., "…encourage me to improve my skills" ; $\alpha = .857$) and thwarting (e.g., "… point out that I will likely fail"; $\alpha = .869$), and relatedness supportive (e.g., "…are interested in what I do"; $\alpha = .871$) and thwarting (e.g., "…do not connect with me"; $\alpha = .873$). Respondents indicated their degree of agreement with the items on a seven-point scale (1 = do not agree at all; 7 = completely agree). The Hungarian version of this questionnaire was obtained by performing a translation/back-translation protocol (Beaton et al. 2000). Rocchi et al. (2017a) and Rodrigues et al. (2019) found support for the factorial validity, the scale score reliability, and the construct validity of the IBQ.

Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) Need fulfilment was assessed with the Hungarian version (Tóth-Király et al. 2018) of the BPNSFS (Chen et al. 2015). The BPNSFS includes 24 items measuring six dimensions with 4 items each: autonomy satisfaction ($\alpha = .767$; e.g., "I feel my choices express who I really am") and frustration ($\alpha = .729$; e.g., "I feel pressured to do too many things"), relatedness satisfaction ($\alpha = .815$; e.g., "I feel close and connected with other people who are important to me") and frustration ($\alpha = .808$; e.g., "I have the impression that people I spend time with dislike me"), and competence satisfaction ($\alpha = .827$; e.g., "I feel competent to achieve my goals") and frustration ($\alpha = .849$; e.g., "I feel insecure about my abilities"). Participants rated each item on a five-point scale (1 = not true at all for me; 5 = very true for me). Findings reported by Tóth-Király et al. (2018) provided empirical support for the BPNSFS' factorial validity, generalizability across gender, and scale score reliability.

Positive and Negative Affect Scale (PANAS) Participants completed the 10-item Hungarian version (Gyollai et al. 2011) of the PANAS (Watson et al. 1988). This instrument is designed to assess positive (5 items; $\alpha = .767$; e.g., active, determined, or inspired) and negative (5 items; $\alpha = .725$; e.g., afraid, hostile, or nervous) affect. Each item was rated on a five-point scale (1 = very slightly or not at all; 5 = very much). Gyollai et al. (2011) found support for the factor structure and scale score reliability of the Hungarian version of the PANAS.

Analyses

Model Estimation

Statistical analyses were performed using the robust maximum likelihood (MLR) estimator implemented in Mplus 8 (Muthén & Muthén 1998–2017). The small amount of missing data at the item level (Study 1: 0%; Study 2: 0% to 0.4%) was handled with full information maximum likelihood (FIML) estimation procedures (Enders 2010). Alternative representations of IBQ ratings were estimated in Study 1 and 2 applying the sequence proposed by Tóth-Király et al. (2018). These CFA, ESEM, and bifactor models are described in greater details in Table S1 of the online supplements.

Measurement Invariance

In order to assess the extent to which our results could be assumed to generalize across studies, we then proceeded to assess the measurement invariance of the most optimal solution. These tests were conducted in the following sequence (Millsap 2011): (1) configural; (2) weak (loadings); (3) strong (intercepts); (4) strict (uniquenesses); (5) latent variance-

covariance; and (6) latent means. With strong invariance, it becomes possible to combine the two samples for tests of invariance across gender.

Criterion-Related Validity

The criterion-related validity of the IBQ was finally assessed by incorporating participants' levels of need fulfillment and affect to the final retained model as outcomes of the need support and thwarting factors. Due to the complexity of these models, it was not possible to include these outcomes as latent variables. For this reason, preliminary measurement models were estimated for the outcomes before their incorporation into the predictive models as factor scores (Tables S4, S8, S9, S10) (Morin et al. 2016b, 2017; Skrondal and Laake 2001). Tests of criterion-related validity were conducted in a multi-group framework to assess the extent to which the relations would generalize across studies, and gender groups in the following sequence: (a) predictions freely estimated; (b) regression slopes constrained to equality, (c) regression intercepts constrained to equality across groups; and (4) regression residuals constrained to equality.

Model Evaluation

We considered sample-size-independent goodness-of-fit indices for the assessment of model fit: The Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) considering typical guidelines (Marsh et al. 2005). Based on typical guidelines (Marsh et al. 2005), values greater than .90 and .95 for the CFI and TLI were respectively taken to reflect adequate and excellent fit, whereas values smaller than .08 or .06 for the RMSEA were respectively taken to indicate acceptable and excellent fit. Nested model comparisons for tests of measurement invariance and predictive similarity were compared via the examination of changes (Δ) in goodness-of-fit indices, where a decrease in CFI and TLI of .010 or higher or an increase in RMSEA of.015 or higher indicate a lack of invariance (Chen 2007; Cheung and Rensvold 2002; Marsh et al. 2005). Reliability was assessed with McDonald's (1970) omega coefficient of composite reliability (ω; Morin et al. 2018).

Morin and colleagues (Morin et al. 2016a) note that, because each alternative model considered here can absorb unmodelled multidimensionality, goodness-of-fit indices are not sufficient to guide the selection of the optimal solution. For this reason, goodness-of-fit information should always be complemented with a thorough examination of parameter estimates (e.g., factor loadings, cross-loadings, factor correlations) for all models that achieve a sufficient level of fit, starting with the comparison of CFA and ESEM solutions to verify whether cross-loadings should be incorporated (Morin et al. 2016a; Morin et al. 2018).

Results

Study 1: Measurement Models

The upper section of Table 1 presents the goodness-of-fit indices associated with all measurement models examined in Study 1. While the fit for most of the first-order CFA and ESEM solutions was unsatisfactory, the fit of the six-factor CFA and ESEM solutions was excellent. It is also interesting to note that the fit of the six-factor ESEM solution (Model 1.7) was substantially higher than that of the six-factor CFA solution (Model 1.6). Inspection of the standardized parameter estimates related to these solutions (see Table 2) revealed well-defined CFA factors but slightly weaker ESEM factors, mainly due to a subset of items (3–5-21) characterized by weak factor loadings on their target factors coupled by multiple cross-loadings on multiple factors. Observing such a generalized undifferentiated pattern of cross-loading on multiple factors suggests that these items may tap into more global levels of need nurturing behaviors relative to their more specific a priori dimensions. With these exceptions, although the ESEM solution includes several statistically significant cross-loadings, none of the other items present a cross-loading large enough (e.g.,≥.400) to suggest a problem in the definition of the factors. Only three other items (1, 12, 15) presented high cross-loadings, all involving oppositely valenced factors. Furthermore, when looking at the factor correlations reported in Table 3, these were smaller in the ESEM solution than in the CFA solutions, in addition to having the appropriate direction (positive among similarly valenced factors, such as support-support, thwarting-thwarting and negative among factors with an opposite valence, such as support-thwarting).

These various considerations led us to retain the ESEM solution. This decision was reinforced when the bifactor solutions were examined, as these also demonstrated the superiority of relying on a bifactor-ESEM solution (relative to a bifactor-CFA solution).[1] In selecting the optimal solution, a key question is whether two G-factors (Model 17) are better than a single G-factor (Model 15), given that both models demonstrated an almost identical level of model fit. An examination of parameter estimates of models including two G-factors is highly informative. In bifactor-CFA (Models 12 and 16), this correlation is high enough to suggest conceptual redundancies between the two G-factors. Despite the fact that these correlations are

[1] For comparison purposes, we also estimated higher-order CFA and ESEM models matching the bifactor solutions. All of these higher-order models demonstrated worse model fit when compared to their bifactor counterparts, and models including two higher-order factors also converged on very high estimates of the correlation between the two higher-order factors. Fit indices associated with these higher-order models are provided in Table S11.

Table 1 Goodness-of-fit statistics for the models estimated on the Interpersonal Behaviours Questionnaire

Model	χ^2	df	CFI	TLI	RMSEA	RMSEA 90% CI
Study 1						
Model 1.1. One-factor CFA (Nu)	2049.822*	252	.788	.767	.096	.092–.100
Model 1.2. Two-factor CFA (Su, Th)	1385.568*	251	.866	.853	.077	.073–.080
Model 1.3. Two-factor ESEM (Su, Th)	1378.734*	229	.864	.836	.081	.077–.085
Model 1.4. Three-factor CFA (A, C, R)	1611.473*	249	.839	.822	.084	.080–.088
Model 1.5. Three-factor ESEM (A, C, R)	721.785*	207	.939	.919	.057	.052–.061
Model 1.6. Six-factor CFA (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th)	594.143*	237	.958	.951	.044	.040–.049
Model 1.7. Six-factor ESEM (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th)	226.187*	147	.991	.982	.026	.019–.033
Model 1.8. B-CFA: Two S-factors (Su, Th) and one G-factor (Nu)	1013.275*	228	.907	.888	.067	.063–.071
Model 1.9. B-ESEM: Two S-factors (S, Fr) and one G-factor (Nu)	721.785*	207	.939	.919	.057	.052–.061
Model 1.10. B-CFA: Three S-factors (A, C, R) and one G-factor (Nu)	952.625*	228	.914	.896	.064	.060–.068
Model 1.11. B-ESEM: Three S-factors (A, C, R) and one G-factor (Nu)	405.083*	186	.974	.962	.039	.034–.044
Model 1.12. B-CFA: Three S-factors (A, C, R) and two G-factors (Su, Th)	440.490*	227	.975	.969	.035	.030–.040
Model 1,13. B-ESEM: Three S-factors (A, C, R) and two G-factors (Su, Th)	393.773*	182	.975	.962	.039	.034–.044
Model 1.14. B-CFA: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and one G-factor (Nu)	851.961*	228	.926	.911	.060	.055–.064
Model 1.15. B-ESEM: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and one G-factor (Nu)	193.618*	129	.992	.984	.025	.018–.033
Model 1.16. B-CFA: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and two G-factor (Su, Th)	686.710*	227	.946	.934	.051	.047–.056
Model 1.17. B-ESEM: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and two G-factor (Su, Th)	187.989*	122	.992	.982	.026	.019–.034
Study 2						
Model 2.1. One-factor CFA (Nu)	2061.123*	252	.773	.752	.098	.094–.102
Model 2.2. Two-factor CFA (Su, Th)	1723.926*	251	.815	.797	.089	.085–.093
Model 2.3. Two-factor ESEM (Su, Th)	1264.733*	229	.870	.844	.078	.074–.082
Model 2.4. Three-factor CFA (A, C, R)	1376.721*	249	.859	.843	.078	.074–.082
Model 2.5. Three-factor ESEM (A, C, R)	758.108*	207	.931	.908	.060	.055–.065
Model 2.6. Six-factor CFA (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th)	552.950*	237	.960	.954	.042	.038–.047
Model 2.7. Six-factor ESEM (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th)	250.609*	147	.987	.976	.031	.024–.037
Model 2.8. B-CFA: Two S-factors (Su, Th) and one G-factor (Nu)	966.991*	228	.907	.888	.066	.062–.070
Model 2.9. B-ESEM: Two S-factors (S, Fr) and one G-factor (Nu)	758.108*	207	.931	.908	.060	.055–.065
Model 2.10. B-CFA: Three S-factors (A, C, R) and one G-factor (Nu)	645.920*	228	.948	.937	.050	.045–.054
Model 2.11. B-ESEM: Three S-factors (A, C, R) and one G-factor (Nu)	366.580*	186	.977	.966	.036	.031–.042
Model 2.12. B-CFA: Three S-factors (A, C, R) and two G-factors (Su, Th)	479.256*	227	.968	.962	.039	.034–.044
Model 2.13. B-ESEM: Three S-factors (A, C, R) and two G-factors (Su, Th)	325.929*	182	.982	.973	.033	.027–.038
Model 2.14. B-CFA: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and one G-factor (Nu)	794.076*	228	.929	.914	.058	.053–.062
Model 2.15. B-ESEM: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and one G-factor (Nu)	201.062*	129	.991	.981	.027	.020–.035
Model 2.16. B-CFA: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and two G-factor (Su, Th)	761.047*	227	.933	.919	.056	.052–.061
Model 2.17. B-ESEM: Six S-factors (A-Su, A-Th, C-Su, C-Th, R-Su, R-Th) and two G-factor (Su, Th)	205.495*	122	.990	.976	.030	.023–.037

CFA Confirmatory factor analysis, *ESEM* Exploratory structural equation modeling, *B* Bifactor model, *Nu* Global need nurturing behaviors, *Su* Need supportive behaviors, *Th* Need thwarting behaviors, *A* Autonomy, *C* Competence, *R* Relatedness, *G-factor* Global factor estimated as part of a bifactor model, *S-factor* Specific factor estimated as part of a bifactor model, χ^2 Robust chi-square test of exact fit, *df* Degrees of freedom, *CFI* Comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* Root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA; *$p < 0.01$

Table 2 Standardized Parameter Estimates from the six-factor CFA and ESEM solutions in Study 1 ($N = 772$): Interpersonal Behaviours Questionnaire

	CFA		ESEM						
	Factor (λ)	δ	A-Su (λ)	C-Su (λ)	R-Su (λ)	A-Th (λ)	C-Th (λ)	R-Th (λ)	δ
Autonomy-support (A-Su)									
Item 1	**.695****	.517	**.419****	.162*	−.011	−.382**	.074	.010	.455
Item 7	**.883****	.221	**.661****	.106*	.080	−.091*	−.046	−.065	.208
Item 13	**.861****	.259	**.652****	.077	.158**	−.069	−.056	.001	.241
Item 19	**.816****	.335	**.497****	.169**	.136*	−.179**	−.009	.004	.347
ω	.888		.799						
Competence-support (C-Su)									
Item 3	**.683****	.533	.469**	**.272****	−.016	.166**	−.053	−.201**	.466
Item 9	**.709****	.498	.014	**.652****	.183	−.129**	.068	−.037	.343
Item 15	**.858****	.264	.170	**.436****	.254**	.052	−.387**	.147**	.230
Item 21	**.841****	.293	.229**	**.213**	.364**	−.003	−.434**	.198**	.224
ω	.857			.662					
Relatedness-support (R-Su)									
Item 5	**.700****	.510	.267**	.359**	**.127**	.133**	−.044	−.208**	.453
Item 11	**.833****	.306	.007	.346**	**.444****	−.108*	.128*	−.261**	.283
Item 17	**.822****	.325	.102	.063	**.620****	.003	.049	−.247**	.274
Item 23	**.816****	.334	.186**	.108	**.501****	−.085*	.079	−.197**	.327
ω	.872				.682				
Autonomy-thwarting (A-Th)									
Item 2	**.732****	.464	−.094	−.010	.002	**.729****	.014	−.039	.411
Item 8	**.815****	.335	−.115*	−.041	.038	**.694****	.076*	.037	.322
Item 14	**.856****	.266	.003	−.027	−.089	**.703****	.146**	.046	.259
Item 20	**.805****	.353	−.271	.155**	−.016	**.528****	.171**	.105	.353
ω	.879					.840			
Competence-thwarting (C-Th)									
Item 4	**.751****	.436	−.074	−.169**	.143*	.150**	**.520****	.142*	.425
Item 10	**.811****	.343	.012	−.088	−.018	.240**	**.433****	.249**	.359
Item 16	**.812****	.341	.073	−.161	−.019	.151**	**.617****	.124**	.322
Item 22	**.746****	.444	−.105	−.027	.090	.107*	**.512****	.249**	.430
ω	.862						.787		
Relatedness-thwarting (R-Th)									
Item 6	**.760****	.422	.064	−.252**	.011	.065	.235**	**.508****	.371
Item 12	**.779****	.393	.055	.114*	−.328**	.120	.118*	**.517****	.375
Item 18	**.802****	.357	−.054	.162**	−.264**	.036	.096	**.629****	.321
Item 24	**.841****	.293	−.060	.017	−.088	.017	.182**	**.664****	.285
ω	.874							.799	

CFA Confirmatory factor analysis, *ESEM* Exploratory structural equation modeling, *Su* Need supportive behaviors, *Th* Need thwarting behaviors, *A* Autonomy, *C* Competence, *R* Relatedness, *λ* Factor loading, *δ* Item uniqueness, *ω* Model-based omega composite reliability, Target factor loadings are in bold; *$p < .05$; **$p < .01$

slightly reduced in bifactor-ESEM, they remain high enough to be problematic. In addition, these models also reveal weakly defined S-factors, large estimates of standard errors, and even negative residual estimates, suggestive of overparameterization and arguing against the inclusion of a second G-factor to the model.

The six-factor ESEM solution and the bifactor-ESEM solution (six S-factors and one G-factor) resulted in an identical level of model fit. Examining the parameter estimates associated with the Model 15, reported in Table 4, provide further support to this bifactor solution. These results reveal a well-defined G-factor with positive loadings associated with the

Table 3 Latent factor correlations from the six-factor CFA (under the diagonal) and ESEM (over the diagonal) solutions in Study 1 (N = 772) and 2 (*N* = 742): Interpersonal Behaviours Questionnaire

	A-Su	C-Su	R-Su	A-Th	C-Th	R-Th
Study 1						
Autonomy-support (A-Su)	–	.625	.584	−.458	−.495	−.425
Competence-support (C-Su)	.921	–	.448	−.364	−.374	−.449
Relatedness-support (C-Su)	.852	.868	–	−.297	−.450	−.518
Autonomy-thwarting (A-Th)	−.742	−.634	−.610	–	.517	.509
Competence-thwarting (R-Th)	−.739	−.799	−.687	.839	–	.416
Relatedness-thwarting (C-Th)	−.694	−.694	−.849	.713	.816	–
Study 2						
Autonomy-support (A-Su)	–	.659	.564	−.554	−.608	−.446
Competence-support (C-Su)	.921	–	.415	−.338	−.428	−.539
Relatedness-support (C-Su)	.832	.890	–	−.300	−.498	−.567
Autonomy-thwarting (A-Th)	−.713	−.620	−.566	–	.573	.401
Competence-thwarting (R-Th)	−.735	−.836	−.709	.755	–	.439
Relatedness-thwarting (C-Th)	−.712	−.759	−.929	.580	.729	–

CFA Confirmatory factor analysis, *ESEM* Exploratory structural equation modeling, *Su* Need supportive behaviors, *Th* Need thwarting behaviors, *A* Autonomy, *C* Competence, *R* Relatedness, All correlations are significant at $p < .01$; These correlations involve latent factors for which the scale was set using the referent indicator approach, and thus having a mean of 0 and a SD of 1

need supportive items and negative loadings associated with the need thwarting items. All need thwarting S-factors retained meaningful specificity. Finally, cross-loadings also decreased in magnitude relative to the six-factor ESEM solution. Based these observations, this bifactor-ESEM solution (Model 15) was retained.

Study 2: Replicating the Final Measurement Structure

Goodness-of-fit indices pertaining to the same set of measurement models estimated in Study 2 are presented in the bottom part of Table 1. Key results matching those reported for Study 1 are reported in Tables S2 and S3 of the online supplements and in the bottom section of Table 3. Examination of these results reinforce our prior conclusions about the superiority of the bifactor-ESEM solution that includes one G-factor and six S-factors (Model 15). To more precisely assess the replicability of Model 15 across studies, tests of measurement invariance were realized. These results (Table 5) supported the complete invariance of the bifactor-ESEM model across samples as none of the changes in fit indices (ΔCFI, ΔTLI, ΔRMSEA) exceeded the recommended guidelines. These results support the replication of the bifactor-ESEM model across studies.

Generalizability of the Results across Gender

Since the complete measurement invariance of the final model was supported across studies, tests of measurement across gender were conducted on the combined sample to maximize sample size and statistical power. The results from these tests (Table 5) support the complete invariance of this solution across genders.

Criterion-Related Validity

Results from the tests of predictive similarity for models incorporating the factor scores representing the outcomes (BPNSFS and PANAS) are reported in the bottom part of Table 5 and support the complete predictive similarity of these results across studies. Tests of predictive similarity conducted across genders also supported the similarity of the regression slopes and residuals across genders, but a change in TLI greater than .010 suggested that the regression intercepts were not fully equivalent across genders (Chen 2007; Cheung and Rensvold 2002; Marsh et al. 2005). Examination of this second set of results revealed that the intercept of the competence satisfaction outcome was slightly lower among females, leading to a model of partial similarity that was supported by the data.

Parameter estimates from the analyses of criterion-related validity are reported in Table 6. Despite the lower level of specificity associated with the IBQ need supportive S-factors, they can still be considered to be fully reliable as they are defined as latent factors in this model. In contrast, all S-factors from the BPNSFS retained a satisfactory amount of specificity (Table S7). Consistent with SDT, the global need nurturing factor was positively associated with the global need fulfillment G-factor from the BPNSFS, as well as with the autonomy satisfaction,

Table 4 Standardized parameter estimates from the bifactor-ESEM solution including six s-factors and one g-factor in Study 1 ($N = 772$): Interpersonal Behaviours Questionnaire

	Nu (λ)	A-Su (λ)	C-Su (λ)	R-Su (λ)	A-Th (λ)	C-Th (λ)	R-Th (λ)	δ
Autonomy-support (A-Su)								
Item 1	**.684****	**.114**	−.050	−.153	−.212**	.190**	.096	.403
Item 7	**.823****	**.304****	.021	.012	−.009	.059	.067	.223
Item 13	**.776****	**.426****	.046	.129**	−.002	−.012	.096**	.188
Item 19	**.767****	**.213****	.037	.003	−.051	.107**	.086	.343
ω		.491						
Competence-support (C-Su)								
Item 3	**.682****	.151*	**−.075**	−.083	.224**	.104	.028	.437
Item 9	**.731****	−.093	**−.115**	.140	.086*	.104	.176**	.375
Item 15	**.815****	−.012	**.238**	.008	.167**	−.074	.193*	.209
Item 21	**.781****	.093	**.340****	.059	.074	−.119	.118	.229
ω			.321					
Relatedness-support (C-Su)								
Item 5	**.680****	.110	−.121	**.202**	.198**	−.035	.051	.428
Item 11	**.756****	−.053	−.087	**.402****	.044	.095*	−.082	.239
Item 17	**.705****	.061	.140*	**.335**	.094	.123	−.248**	.282
Item 23	**.732****	.079	.093	**.262**	.032	.147	−.165**	.331
ω				.530				
Autonomy-thwarting (A-Th)								
Item 2	**−.552****	.033	.019	.119*	**.537****	−.018	−.010	.391
Item 8	**−.622****	−.026	.085	.013	**.526****	.126**	−.013	.312
Item 14	**−.670****	.046	−.011	.021	**.513****	.122**	.067	.266
Item 20	**−.633****	−.153**	−.027	.037	**.436****	.155	.110*	.348
ω					.755			
Competence-thwarting (R-Th)								
Item 4	**−.652****	.034	−.017	.133	.122**	**.339****	.006	.426
Item 10	**−.703****	.063	−.035	.060	.185**	**.278****	.156**	.360
Item 16	**−.687****	.076	−.119**	.044	.122**	**.415****	.058	.316
Item 22	**−.638****	−.010	−.036	.088	.122**	**.351****	.126*	.430
ω						.559		
Relatedness-thwarting (C-Th)								
Item 6	**−.705****	.144	.163**	−.041	.015	.176	**.221****	.373
Item 12	**−.622****	.079	−.044	−.138**	.089*	.033	**.459****	.367
Item 18	**−.639****	.015	−.004	−.084	.032	.010	**.535****	.297
Item 24	**−.702****	.034	.117	−.074	.023	.128*	**.424****	.290
ω	.973						.669	

CFA Confirmatory factor analysis, *ESEM* Exploratory structural equation modeling, *S-Factors* Specific factors from the bifactor model, *Nu* Global need nurturing behaviors, *Su* Need supportive behaviors, *Th* Need thwarting behaviors, *A* Autonomy, *C* Competence, *R* Relatedness, λ Factor loading, δ Item uniqueness, ω Model-based omega composite reliability, Target factor loadings are in bold; *$p < .05$; **$p < .01$

competence satisfaction, and relatedness satisfaction S-factors. This global need nurturing factor was also negatively associated with the autonomy frustration and relatedness frustration S-factors of the BPNSFS, as well as with negative affect. This global need nurturing factor was also positively associated with positive affect. As expected, fewer statistically significant relations were found at the level of the IBQ S-factors.

Still, many of these additional associations matched SDT, with few exceptions: (a) specific imbalance in terms of relatedness support were positively associated with the competence and autonomy frustration S-factors of the BPNSFS; (b) specific imbalance in terms of competence thwarting were positively associated with the autonomy satisfaction S-factor of the BPNSFS, whereas specific imbalance in terms of competence support were negatively related to the relatedness

Table 5 Measurement invariance for the final retained model on the Interpersonal Behaviours Questionnaire

Model	χ^2 (df)	CFI	TLI	RMSEA	90% CI	Comparison	$\Delta\chi^2$ (df)	ΔCFI	ΔTLI	ΔRMSEA
Sample invariance										
S1. Configural invariance	394.268 (258)*	.992	.982	.026	.021–.032	–	–	–	–	–
S2. Weak invariance	535.300 (377)*	.990	.986	.024	.019–.028	S1	146.846 (119)	−.002	+.004	−.002
S3. Strong invariance	568.517 (394)*	.989	.985	.024	.020–.028	S2	38.635 (17)*	−.001	−.001	.000
S4. Strict invariance	721.312 (418)*	.982	.976	.031	.027–.035	S3	113.308 (24)*	−.007	−.009	+.007
S5. Latent var.-covar. Invariance	760.470 (446)*	.981	.976	.031	.027–.034	S4	43.592 (28)	−.001	.000	.000
S6. Latent means invariance	780.035 (453)*	.980	.976	.031	.027–.035	S5	19.433 (7)*	−.001	.000	.000
Gender invariance										
G1. Configural invariance	437.078 (258)*	.989	.977	.030	.025–.035	–	–	–	–	–
G2. Weak invariance	537.279 (377)*	.990	.986	.024	.019–.028	G1	125.169 (119)	+.001	+.009	−.006
G3. Strong invariance	558.178 (394)*	.990	.986	.023	.019–.028	G2	19.699 (17)	.000	.000	−.001
G4. Strict invariance	616.321 (418)*	.988	.984	.025	.021–.029	G3	52.491 (24)*	−.002	−.002	+.002
G5. Latent var.-covar. Invariance	624.523 (446)*	.989	.987	.023	.019–.027	G4	25.924 (28)	+.001	+.003	−.002
G6. Latent means invariance	650.507 (453)*	.988	.985	.024	.020–.028	G5	33.163 (7)*	−.001	−.002	+.001
Criterion validity across samples										
CS1. Freely estimated	1206.719 (759)*	.979	.971	.028	.025–.031	–	–	–	–	–
CS2. Invariant regression slopes	1317.818 (822)*	.977	.971	.028	.025–.031	CS1	110.974 (63)*	−.002	.000	.000
CS3. Invariant regression intercepts	1344.997 (831)*	.976	.970	.029	.026–.031	CS2	32.529 (9)*	−.001	−.001	+.001
CS4. Invariant regression residuals	1476.195 (840)*	.971	.963	.032	.029–.034	CS3	157.610 (9)*	−.005	−.007	+.003
Criterion validity across genders										
CG1. Freely estimated	1122.567 (759)*	.984	.977	.025	.022–.028	–	–	–	–	–
CG2. Invariant regression slopes	1213.899 (822)*	.982	.977	.025	.022–.028	CG1	91.504 (63)	−.002	.000	.000
CG3. Invariant regression intercepts	1424.042 (831)*	.973	.966	.031	.028–.033	CG2	235.535 (9)*	−.009	−.011	+.006
CG3p. Invariant intercepts (partial)	1343.905 (830)*	.977	.970	.029	.026–.031	CG2	157.290 (8)*	−.005	−.007	+.004
CG4. Invariant regression residuals	1373.750 (839)*	.976	.969	.029	.026–.032	CG3p	30.524 (9)*	−.001	−.001	.000

χ^2 Robust chi-square test of exact fit, *df* Degrees of freedom, *CFI* Comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* Root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA; $\Delta\chi^2$ = Robust (Satorra-Bentler) chi-square difference test (calculated from loglikelihood for greater precision); Δ: Change in model fit in relation to the comparison model; *$p < .01$

satisfaction S-factor of the BPNSFS; and (c) specific imbalance in autonomy thwarting were positively related to the relatedness satisfaction S-factor of the BPNSFS, whereas specific imbalance in autonomy support were positively related to the relatedness frustration S-factor of the BPNSFS. It is important to keep in mind these S-factors reflect the specificity that remains in participants' rating of autonomy support once their global perceptions regarding the extent to which their basic needs are nurtured by their environment are partialled out from these ratings. As such, these relations can be taken to directly reflect feelings of imbalance in the degree to which one need is supported relative to the others.

Discussion

The present series of two studies sought to propose an improved representation of the multidimensional structure of need supportive and need thwarting interpersonal behaviors ratings via the application of emerging bifactor-ESEM methodology (Morin et al. 2016a). In the present research, this framework allowed us to identify one overarching need nurturing G-factor underlying participants' responses to the IBQ (Rocchi et al. 2017a, 2017b), from six specific need supportive and need thwarting S-factors reflecting behavioral imbalance.

The Structure of Need Nurturing Behaviors

Our final solution revealed a well-defined need nurturing G-factor associated with positive factor loadings to the need supportive items and negative factor loadings to the need thwarting items. We also considered alternative models including two G-factors (need supportive behaviors and need nurturing behaviors). Although these alternative models achieved a satisfactory level of model fit, they resulted in highly correlated G-factors, thus calling the discriminant validity of these G-factors into question. These results thus

Table 6 Criterion-related validity of the Interpersonal Behaviours Questionnaire

	General need fulfillment		Autonomy satisfaction		Competence satisfaction	
	b	β	b	β	b	β
General need nurturing	.573**	.608	.044*	.061	.083**	.109
Autonomy support	.045	.048	−.007	−.010	.018	.023
Competence support	.154**	.163	.026	.036	.159**	.208
Relatedness support	.053	.057	.010	.013	−.014	−.019
Autonomy thwarting	−.070**	−.074	−.027	−.037	−.010	−.014
Competence thwarting	−.022	−.023	.075*	.103	.051	.066
Relatedness thwarting	−.109**	−.115	.011	.016	.070	.092
	Relatedness satisfaction		Autonomy frustration		Competence frustration	
	b	β	b	β	b	β
General need nurturing	.153**	.170	−.069**	−.085	.022	.027
Autonomy support	−.003	−.003	.024	.030	.072	.087
Competence support	−.162**	−.180	.049	.061	−.122**	−.148
Relatedness support	.343**	.382	.092**	.113	.087*	.105
Autonomy thwarting	.101**	.112	.234**	.288	.056	.069
Competence thwarting	.004	.005	−.062	−.077	.122**	.148
Relatedness thwarting	−.096*	−.107	.034	.042	.120**	.146
	Relatedness frustration		Positive affect		Negative affect	
	b	β	b	β	b	β
General need nurturing	−.185**	−.222	.349**	.402	−.344**	−.415
Autonomy support	.104*	.125	.032	.036	.031	.037
Competence support	−.055	−.066	.153**	.176	−.060	−.072
Relatedness support	−.066*	−.079	.040	.046	.000	.000
Autonomy thwarting	.026	.031	.030	.034	.104**	.125
Competence thwarting	−.038	−.045	.039	.045	.025	.031
Relatedness thwarting	.378**	.453	−.016	−.019	.131**	.158

b Unstandardized regression coefficient, *β* Standardized regression coefficient; *$p < .05$; **$p < .01$

argued in favor of a solution where a single G-factor was required to represent the globality of need nurturing behaviors. Thus, the seemingly divergent perspectives discussed in the introduction appeared to be complementary in nature: Perceptions of need supportive and need thwarting interpersonal behaviors appeared to be driven by a global need nurturing dimension, which co-existed with specific levels of imbalance in autonomy, competence, and relatedness need supportive and thwarting behaviors remaining unexplained by the global factor. At the global level, this representation matched that found by Tóth-Király et al. (2018) to underpin the structure of need fulfillment.

Still, the three need thwarting S-factors retained meaningful specificity over and above the G-factor, while the need supportive S-factors appeared to be weakly defined and to retain a very low level of specificity after the global levels of need nurturing perceptions were explicitly taken into account. Although not all S-factors need to retain a meaningful level of specificity in bifactor modeling (Morin et al. 2018), they show that participants' ratings of need supportive interpersonal behaviors mainly serve to define their global perceptions regarding their need nurturing interpersonal context. In contrast, although their ratings of need thwarting interpersonal behaviors also appear to contribute in a meaningful manner to their perceptions of their global need nurturing interpersonal context, they also appear to tap into something unique not explained by these global perceptions. This observation is not without evoking Herzberg's (1964) two factor theory of motivation in which motivators (environmental characteristics related to higher levels of satisfaction) were differentiated from hygiene factors (environmental characteristics whose absence leads to higher levels of dissatisfaction). Arguably, this representation of need supportive and need thwarting interpersonal behaviors is an important contribution of the present research, and implies that researchers should consider the potential relevance of the bifactor-ESEM framework for their own research on need nurturing behaviors.

Need Nurturing Behaviors, Need Fulfillment, and Affect

A second key contribution of this study was to assess the criterion-related validity of the final solution, and most

importantly to assess whether the specific levels of imbalance in need supportive and need thwarting would explain outcome variance beyond that explained by the global need nurturing G-factor. A first result from these analyses was that the relations between participants' IBQ ratings and their levels of need satisfaction, need frustration, and affect were clearly dominated by the effects of global need nurturing perceptions. In accordance with our expectations (Niemiec et al. 2006; Pulido et al. 2018; Rocchi et al. 2017a), our results showed that participants' global perceptions of need nurturing behaviors presented positive relations with all of the desirable outcome measures considered in this study, and negative relations with most of the less desirable outcome measures. This global need nurturing factor also emerged as the strongest predictor of participants' scores on the more global outcomes (global need fulfillment, positive affect, and negative affect).

In contrast, the effects of specific imbalance in the perceptions of autonomy, competence, and relatedness supportive and thwarting behaviors were far less widespread, being typically limited to a much smaller number of outcomes. This observation is aligned with the observation that at least some of these S-factors only included a limited amount of residual specificity. However, our results also revealed a substantial number of outcome associations located at the level of these specific factors, many of which were aligned with SDT, and all of whom could be explained by prior theoretical developments.

Specific Levels of Imbalance in Autonomy Need Thwarting Behaviors Specific levels of imbalance in autonomy need thwarting behaviors were associated with lower levels of global need fulfillment, and with higher levels of autonomy need frustration and negative affect. Thus, when social agents (e.g., parents) are perceived as seeking to control or limit participants' freedom through pressure, intimidation, or rewards (Bartholomew et al. 2009), participants are more likely to experience (a) a global decrease in their levels of need fulfillment, (b) feelings of frustration of their needs for autonomy, and (c) more frequent negative affect.

Specific Levels of Imbalance in Relatedness Need Supportive and Thwarting Behaviors Specific levels of imbalance in relatedness need supportive behaviors were associated with higher levels of relatedness need satisfaction and lower levels of relatedness need frustration. Interpersonal behaviors characterized by understanding, support, warmth, interest, and liking (Jones et al. 2004) thus appeared beneficial in terms of increasing feelings of satisfaction and decreasing feelings of frustration of participants' needs for relatedness. Likewise, specific imbalance in relatedness need thwarting behaviors were related to lower levels of global need fulfillment and relatedness need satisfaction, as well as with higher levels of competence need frustration, relatedness need frustration, and negative affect. These findings are aligned with those from previous results revealing the negative impact of experiences of loneliness (i.e., frustrated relatedness needs) for a variety of maladaptive outcomes (Mellor et al. 2008; Valtorta et al. 2016).

Specific Levels of Imbalance in Competence Need Supportive and Thwarting Behaviors Specific imbalance in competence need supportive behaviors were related to higher levels of global need fulfillment, competence need satisfaction, and positive affect, as well as with lower levels of competence need frustration. These results suggest that perceiving one's environment as being supportive to learning, able to provide constructive feedback, and as providing a positive impetus for improvement (Sheldon and Filak 2008) is conductive to positive affect, need fulfillment, and competence need satisfaction, and of lower levels of competence need frustration. The relations pertaining to specific imbalance in competence need supportive are particularly interesting, given that previous studies (Sánchez-Oliva et al. 2017) have also highlighted competence as an important predictor of outcomes over and above the need satisfaction G-factor. The present results add to this earlier evidence by showing specific imbalance in competence need thwarting behaviors to be associated with higher levels of competence need frustration.

Need Imbalance Some results appear counter-intuitive at first sight, such as the observation of positive relations between specific imbalance in autonomy need supportive behaviors and relatedness need frustration, between specific imbalance in autonomy need thwarting behaviors and relatedness need satisfaction, between specific imbalance in competence need thwarting behaviors and autonomy need satisfaction, and between specific imbalance in relatedness need supportive behaviors and autonomy/competence needs frustration, as well as of negative associations between specific levels of imbalance in competence need supportive behaviors and relatedness need satisfaction. These results need to be interpreted while keeping in mind the specific characteristics of the bifactor structure which has produced them. Although the G-factor reflecting global levels of need nurturing behaviors can directly be interpreted as ranging from a very low to a very high level of need nurturance, the interpretation of the S-factors is not as straightforward. These S-factors reflect what remains at the subscale level once the variance explained by global levels of need nurturing behaviors is partialled out. In other words, these S-factors can be taken to reflect discrepancies, or imbalance, in the degree to which participants' specific needs for autonomy, competence, and relatedness are supported or thwarted by the environment over and above this global level of need nurturance.

Previous research focusing on the satisfaction of the three psychological needs for autonomy, competence, and relatedness

has also invoked the need to consider the possible impact of need imbalance (e.g., Dysvik et al. 2013; Sheldon and Niemiec 2006). For instance, Sheldon and Niemiec (2006) argued that to adequately understand the combined effects of need satisfaction, one needed to consider the extent to which the satisfaction of the three basic needs would be in alignment. The present study thus lends support to this hypothesis as applied to need nurturing behaviors, while simultaneously demonstrating how a bifactor-ESEM operationalization can be used to obtain a rigorous, yet simple, test of this hypothesis. For example, our results suggest that having strong relationships may impede one's autonomy or ability to express one's competence or to act in a fully autonomous manner.

Limitations and Directions for Future Research

The present study has its own limitations. First, we relied on self-report measures that can be influenced by self-report biases as well as by social desirability. Thus, we encourage researchers to consider more objective data (e.g., turnover) as well as informant-reported (e.g., supervisor) measures of performance. Second, although our treatment of need fulfillment and affect as outcomes was based on theoretical considerations, our design did not allow us to rule out the possibility of spurious associations, reciprocal influence, or reverse causality. Future longitudinal research should devote more attention to the identification of the true directionality of the associations among interpersonal behaviors and outcomes, as well as the developmental mechanisms involved in emergence, stability, and change in these various constructs.

Practical and Methodological Implications

Despite these limitations, our results suggest that need nurturing behaviors should be encouraged as these behaviors appeared to be positively associated with participants' autonomy, competence, and relatedness needs fulfillment, as well as with more positive affect. This conclusion ties in previous research showing that contributing to the creation of a social environment that satisfies the basic psychological needs for autonomy, competence, and relatedness through the provision of autonomy support, involvement, and structure leads to increased levels of need satisfaction and well-being, autonomous motivation, engagement, and prosocial behaviors (for an overview, see Ryan and Deci 2017). Autonomy support is related to the presence of alternative choices and the provision of a rationale for engaging in activities, as well as to the minimization of the use of controlling behaviors and evaluative communications. Involvement is present when the social agents are concerned with the person and understand his/her perspective. Finally, structure is the foundation of the need for competence and refers to perceived associations between how one behaves and what the result of these behaviors is going to be. An optimal structure is achieved by setting optimal, yet challenging tasks, explicit rules and directions for improvement, and clear guidelines.

Our results also add to accumulating evidence supporting the bifactor-ESEM framework for SDT research, providing researchers a way to obtain direct global estimates of participants quantity of self-determined motivation disaggregated from the specific levels of imbalance in the quality of their types of behavioral regulation (Howard et al. 2018; Litalien et al. 2017), as well as direct global and direct estimates of need fulfillment disaggregated from specific and non-redundant levels of imbalance in competence, autonomy, and relatedness need satisfaction and frustration (Gillet et al. 2017; Sánchez-Oliva et al. 2017; Tóth-Király et al. 2018). For research purposes, our study reinforces the need for SDT researchers to rely on similar methods when investigating these constructs. Our results suggest that failure to consider the global and specific components of need nurturing behaviors is likely to lead to erroneous conclusions that the need supporting and thwarting behaviors are relatively independent constructs. For applied researchers, this in turn could lead to biased practical recommendations. Our results also illustrate a reliable method that can be used to obtain a more precise and direct estimate of the global and specific components of need nurturing as bifactor models weight items based on their contribution to the global and specific factors simultaneously. To make this process seamless, as suggested by Perreira et al. (2018), automated scoring procedures could be developed, or the Mplus statistical package could be used to this end, which has the advantage of providing standardized measurements interpretable as a function of the sample mean and standard deviation, just like normed scores. Still, future studies should rely on more representative samples prior to developing scoring procedures.

Our results thus underscore the necessity to rely on the bifactor-ESEM framework to achieve a way to simultaneously consider the global need nurturing social context, properly disaggregated from the specific levels of imbalance in need supportive and thwarting behaviors to which participants are exposed. In doing so, our results demonstrated that need thwarting behaviors were something more than simply a lack of need nurturing, and retained a substantial amount of specificity over and above participants' global need nurturing perceptions. These findings are congruent with Vansteenkiste and Ryan's (2013) mention that the mere absence of need satisfaction does not necessarily equal the presence of need frustration. The present research demonstrated one potential way for more precisely assessing specific levels of imbalance in need thwarting effects. In addition, these results also suggest that need imbalance could play a more important role than previously expected (Dysvik et al. 2013).

Acknowledgements The first author was supported in the preparation of the manuscript by a Horizon Postdoctoral Fellowship from Concordia University and by the ÚNKP-17-3 New National Excellence Program of the Ministry of Human Capacities from Eötvös Loránd University. The second author was supported by a grant from the Social Sciences and Humanities Research Council of Canada (435-2018-0368). The fourth author was supported by a postdoctoral fellowship from the SCOUP Team – Sexuality and Couples – Fonds de recherche du Québec, Société et Culture. The seventh author was supported by the Hungarian Research Fund (NKFI FK 124225). The previous version of this paper was written while the first author was doing his PhD studies at Eötvös Loránd University.

Compliance with Ethical Standards

Conflict of Interest All authors declare that they have no conflict of interest.

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