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Perfectionism and Exercise Dependence: the Role of Basic Psychological Needs and Introjected Regulation

Daniel P. Biggs¹ · Sarah H. Mallinson-Howard² · Gareth E. Jowett³ · Howard K. Hall⁴

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Abstract

Using a self-determination theory (SDT) framework, the aims of our study were to examine the perfectionism-exercise dependence relationships, and whether basic psychological needs and introjected regulation explained these relationships. Distance runners ($n = 260$, M age = 42.41 years; $SD = 11.95$ years, $n = 144$ female) completed measures of multidimensional perfectionism (self-oriented perfectionism (SOP); socially prescribed perfectionism (SPP)), basic psychological need satisfaction and thwarting, introjected regulation, and exercise dependence. Bivariate correlations revealed significant positive SOP-exercise dependence and SPP-exercise dependence relationships. Structural equation modeling suggested that, in combination, perfectionism, basic psychological need satisfaction/thwarting and introjected regulation accounted for large amounts of variance in exercise dependence. Tests of indirect effects showed that the SPP-exercise dependence relationship was mediated by basic psychological need thwarting and introjected regulation. Our findings suggest that while the SOP-exercise dependence relationship is more direct, need thwarting and introjected regulation represent a motivational signature of SPP and exercise dependence.

Keyword Perfectionism · Exercise dependence · Introjected regulation · Needs thwarting · Needs satisfaction · Distance runners · Motivation

Exercise affords a myriad of potential psychological (e.g., reduced risk of depression) and physical (e.g., improved cardiovascular function) health benefits (Northey et al., 2019). However, for approximately 3–9% of exercisers, exercise is chronic, obsessive, and dependent (Marques et al., 2019). This dependence can have substantial psychological,

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interpersonal, and physical costs (e.g., mood disturbance, elevated anxiety, neglecting loved ones, and exercising despite injury; Hausenblas et al., 2017). Therefore, understanding the factors that predict and explain exercise dependence has been a key goal for researchers (see Bircher et al., 2017 for a systematic review). Perfectionism is a multidimensional personality disposition characterized by setting exacting standards, striving for perfection and harsh criticism (Flett & Hewitt, 2002). Perfectionism is one of the most pertinent factors to have emerged from work in this area and consistently and positively correlated with exercise dependence across several studies (Costa et al., 2016; Deck et al., 2021). Several socio-cognitive factors have emerged that, in part, explain the perfectionism-exercise dependence relationship (e.g., psychological need thwarting, Costa et al., 2016 and self-worth, Hall et al., 2009). However, these studies have tended to focus on one socio-cognitive mediator in isolation, when the mechanisms underlying exercise dependence are more complex. In the present study, we adopted an encompassing self-determination theory (SDT) framework that considers a socio-psychological perspective to examine whether basic psychological needs and introjected regulation explain the perfectionism-exercise dependence relationship.

Exercise Dependence

Exercise dependence can be defined as a maladaptive pattern of excessive exercise that manifests in physiological and psychological and cognitive symptoms (Hausenblas & Downs, 2002). In contrast, exercise addiction has been explained as a means to abscond from major life traumas or stress (Juwono et al., 2021). The most common model of exercise dependence follows the DSM-5 criteria of substance dependence (Hausenblas & Downs, 2002). In this model, there are seven symptoms of exercise dependence: (1) an increased *tolerance* for exercise; (2) the occurrence of *withdrawal* symptoms for exercise (e.g., anxiety, fatigue); (3) exercise being performed in excessive quantities to achieve the *intention effect*; (4) *loss of control* is a tireless desire or unsuccessful effort to reduce or regulate exercise; (5) excessive *time* being spent in activities necessary to obtain exercise (e.g., holidays are exercise related); (6) shunning or reducing important occupational, social or recreational activities that *conflict* with exercise; and (7) *continuance* occurs when exercise is continued despite knowledge of having a persistent or recurrent physical or psychological ailment that could have been initiated or be aggravated by exercise (Hausenblas & Downs, 2002).

When exercise dependence has been examined as an end outcome for exercisers (i.e., primary exercise dependence), several personality factors have emerged as potential determinants. As aforementioned, arguably the most pertinent of these factors is perfectionism. Compared to other personality factors, perfectionism has been more frequently identified as a key correlate of exercise dependence. Perfectionism has also explained a greater amount of variance in exercise dependence compared to other psychological factors such as self-esteem or Narcissism (Bircher et al., 2017).

Perfectionism and Exercise Dependence

While different models of perfectionism have been used to examine the link between perfectionism and exercise dependence, such as Mavrandrea and Gonidakis' (2022) use of The Almost Perfect Scale (Slaney et al., 2001) and Costa et al.'s (2016) use of the Frost

Multidimensional Perfectionism Scale (Frost et al., 1990), Hewitt and Flett's (1991a) multidimensional model is particularly useful. This is because it captures both intrapersonal and interpersonal dimensions of perfectionism relevant in predicting symptoms of exercise dependence. Hewitt and Flett (1991a) posit that the pursuit of perfection can be imposed by oneself (self-oriented perfectionism (SOP)) or imposed by others (socially prescribed perfectionism (SPP)). The consequences of these two dimensions of perfectionism are typically divergent in most areas of people's lives; with SPP a consistent source of motivation and well-being difficulties and SOP less so (Hill et al., 2018). However, in the specific context of exercise, SOP may be relatively more problematic. While SOP and SPP have both emerged as positive predictors, SOP tends to be a relatively stronger positive predictor of exercise dependence symptoms than SPP (Bircher et al., 2017; Deck et al., 2021). Hewitt and Flett's (1991a) model also includes perfectionism imposed onto others (other-oriented perfectionism; OOP). However, due to the self-referenced nature of exercise dependence, OOP is likely to be less relevant for exercise dependence than SOP and SPP is and so is not considered further here.

Explaining the Relationship Between Perfectionism and Exercise Dependence

While different explanations have been offered for the link between perfectionism and exercise dependence, the most encompassing comes from SDT (Ryan & Deci, 2017). SDT is a meta-theory of human motivation, which considers the interaction between individuals' tendencies toward healthy functioning and the environmental features that either nurture or inhibit these tendencies (Ryan & Deci, 2017). Basic psychological need theory (BPNT), a key sub-theory of SDT, suggests that satisfaction of three basic psychological needs is integral to the healthy functioning of individuals. These needs are autonomy (feelings of volition, choice, and self-directedness), competence (perceptions of being effective), and relatedness (feelings of belonging or connectedness to others; Ryan & Deci, 2017). When these needs are satisfied in a specific context, such as exercise, optimal functioning and well-being should ensue. By contrast, if exercisers feel their needs are being thwarted, they are at risk of suboptimal functioning and ill-being.

BPNT provides one explanation for the perfectionism-exercise dependence relationship because SOP and SPP potentially may underpin the perception that basic psychological needs are being thwarted (Costa et al., 2016). Striving for something that cannot be achieved alongside harsh self- and other-criticism thwarts competence; the compulsion to pursue perfection restricts autonomy; and the selfish singular focus on perfectionistic striving—or worse the pursuit of exacting standards imposed by significant others combined with the threat of harsh criticism—undermines relatedness. Thus, thwarting of needs shaped by SOP and SPP in theory manifests in an unhealthy relationship with exercise.

However, for SOP the picture is more complex, as SOP may shape perceived needs satisfaction. Specifically, self-oriented perfectionists may perceive competence satisfaction due to elevated capacity for exercise, feel a conflicted sort of autonomy satisfaction i.e., a sense of personal choice to engage chronically in exercise, and may derive a sense of relatedness when exercising amongst others who have similar approaches to exercise. The links between SOP and needs satisfaction are fragile and confer vulnerability. They are liable to breakdown should self-oriented perfectionists experience anything that blocks their exercise goals, due to exercise being a means for self-validation (Hall et al., 2007).

Therefore, needs satisfaction shaped by SOP may perpetuate the ill-being outcome of exercise dependence, rather than reduce it.

Basic psychological needs are yet to be examined as a mediator of the SOP-exercise dependence or SPP-exercise dependence relationships. However, when adopting the Frost et al. (1990) model of perfectionism, Costa et al. (2016) found that a composite needs thwarting variable mediated the relationship between perfectionistic concerns (a combination of concern over mistakes and doubts about action) and exercise dependence. Researchers have also found that when perfectionistic concerns contain SPP, they are associated with needs thwarting (Mallinson & Hill, 2011). Further, needs thwarting predicts exercise dependence (Schüler et al., 2018). However, some important questions remain following this work. Most notably, whether these findings will replicate with SOP, how the relationships will manifest with basic psychological needs satisfaction, and whether related components of SDT, namely motivation regulation, can provide further understanding about the motivational signature of perfectionism and exercise dependence.

Within SDT, the extent to which basic psychological needs are satisfied or thwarted regulates why people are motivated to enact certain behaviors, including exercise, and how activities are internalized into a person's identity. Specifically, motivational regulations exist on a continuum from the least autonomous and non-internalized, namely amotivation (i.e., lack of motivation), to external regulation (i.e., to gain reward or to avoid punishment), to introjected regulation (i.e., to gain praise, preserve pride or avoid guilt), to identified regulation (i.e., accepting the underlying value of the activity), to integrated regulation (i.e., integrating the importance of an activity with one's values and identity), to the most autonomous and internalized, namely intrinsic motivation (i.e., engaging purely for enjoyment and satisfaction). In the case of perfectionism and exercise dependence, exercise is internalized and regulated in a controlled manner due to self-worth becoming contingent on achieving perfection through exercise either for oneself (SOP) or for others (SPP; Hall et al., 2009). Attempts to preserve self-worth in this way reflect the approval seeking and guilt avoidance that reflect introjected regulation (Ryan & Deci, 2017).

Previous findings highlight that introjected regulation is positively correlated with SOP, SPP, and elevated levels and frequency of exercise (Longbottom et al., 2012). The most autonomous and internalized regulations have shown variation of statistical significance with perfectionism and exercise dependence whereas the lesser autonomous and internalized motivational regulations, such as introjected regulation, have demonstrated larger correlations and been a stronger predictor of exercise dependence and perfectionism (Gonzalez-Cutre & Sicilia, 2012; Longbottom et al., 2012; Parastatidou et al., 2014). Other motivational regulation researchers have also found introjected regulation shares small negative or non-significant correlations with basic psychological needs satisfaction in exercisers (Edmunds et al., 2006; Gonzalez-Cutre & Sicilia, 2012), but the associations with basic psychological needs thwarting have yet to be examined. Taken together, alongside basic psychological needs, introjected regulation appears to constitute a potential motivational signature of perfectionism and exercise dependence.

The Present Study

Recent systematic reviews (e.g., Bircher et al., 2017) attest to the central role of perfectionism in exercise dependence and demonstrate the relative strength of relationship for SOP and SPP. Researchers have begun to identify the mechanisms that explain these

relationships, with basic psychological needs thwarting emerging as an important mediator (Costa et al., 2016). However, researchers have yet to examine a more encompassing SDT explanation of the perfectionism-exercise dependence relationships that considers the motivational signature of exercise dependence, as well as basic psychological needs. Therefore, the aim of our study was to examine the SOP-exercise dependence and SPP-exercise dependence relationships and whether basic psychological needs satisfaction, basic psychological needs thwarting, and introjected regulation mediated these relationships. We hypothesized that (a) SOP would share a positive relationship with exercise dependence, and basic psychological needs satisfaction, basic psychological needs thwarting and introjected regulation would mediate this relationship, and (b) SPP would share a positive relationship with exercise dependence and basic psychological needs thwarting and introjected regulation would mediate this relationship.

Method

Participants and Procedure

Participants were 260 adult middle-to-long distance runners (144 females, 113 males and 3 non-responders, M age = 42.41 years, SD = 11.59 years). Participants were recruited from recreational running clubs or groups in the UK. Ethical approval was granted by the second authors' university, and each participant provided informed consent before completion of the study questionnaire. Runners' self-reported levels of competition were recreational (n = 135), club (n = 87), district (n = 14), county (n = 11), regional (n = 4), national (n = 6), and non-responders (n = 3). On average, participants had been running for 5.20 years (SD = 6.06) and spent 5.1 h running per week (SD = 3.77). Their primary running disciplines were 5KM (n = 72), 10KM (n = 57), half marathon (n = 47), marathon (n = 30), ultramarathons (n = 48), and non-responders (n = 3).

Measures

Multidimensional Perfectionism The short form Multidimensional Perfectionism Scale (HF-MPS; Cox et al., 2002) was used to measure SOP (e.g., “*I strive to be as perfect as I can be*”) and SPP (e.g., “*people expect more from me than I am capable of giving*”). Each subscale comprises five items and is measured on a seven-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). Previous studies support the reliability of the full version of the HF-MPS (Hewitt & Flett, 1991b) in similar samples (e.g., SOP α = 0.89, SPP α = 0.83; Hall et al., 2009), and the short form displayed superior psychometric properties relative to the full version in Cox et al. (2002). Cronbach alpha for this study was SOP 0.83 and SPP 0.83.

Basic Psychological Needs Satisfaction The Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson et al., 2006b) was used to measure basic psychological needs satisfaction. The PNSE is an 18-item questionnaire that includes three subscales: autonomy satisfaction (e.g., “*I feel free to exercise in my own way*”), competence satisfaction (e.g., “*I feel confident I can do even the most challenging exercises*”) and relatedness satisfaction (e.g., “*I feel connected to the people who I interact with while we exercise together*”). The subscales were scored on a 7-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly*

agree) Previous studies support the reliability of the subscales ($\alpha \geq 0.90$; Wilson et al., 2006b). Cronbach Alpha for this study was 0.88.

Basic Psychological Needs Thwarting The Psychological Need Thwarting Scale (PNTS; Bartholomew et al., 2011a) was used to measure need thwarting. The PNTS is a 12-item measure that includes three subscales: autonomy thwarting (e.g., “I feel forced to follow training decisions made for me”), competence thwarting (e.g., “There are situations where I am made to feel inadequate”), and relatedness thwarting (e.g., “I feel other people dislike me”). The subscales were scored on a 6-point Likert scale from 1 (*strongly disagree*) to 6 (*strongly agree*). Previous studies support the reliability of the subscales ($\alpha \geq 0.84$; Bartholomew et al., 2011b). Cronbach Alpha for this study was 0.86.

Introjected Regulation The Behavioural Regulation in Exercise Questionnaire 3 (BREQ-3; Markland & Tobin, 2004; Wilson et al., 2006a) was used to measure introjected regulation. The introjected regulation (e.g., “I feel guilty when I don’t exercise”) subscale of the BREQ-3 is 4-item measure scored on a five-point Likert scale (1 = *not true for me* to 5 = *very true for me*). Previous studies support the reliability of the introjected regulation subscale ($\alpha = 0.91$; Rodrigues et al., 2020). Cronbach alpha for this study was 0.81.

Exercise Dependence The Exercise Dependence Scale (EDS; Hausenblas & Downs, 2002) was used to measure exercise dependence. The EDS is a 21-item scale, scored on a six-point Likert scale (1 = *never* to 6 = *always*). It includes seven subscales: tolerance (e.g., “I continually increase my exercise intensity to achieve the desired effects/ benefits”); withdrawal (e.g., “I exercise to avoid feeling irritable”); intention effects (e.g., “I exercise longer than I intend”); lack of control (e.g., “I am unable to reduce how long I exercise”); time (e.g., “I spend a lot of time exercising”); reduction in other activities (e.g., “I would rather exercise than spend time with family/friends”); and continuance (e.g., “I exercise despite recurring physical problems”). Previous studies support the reliability of the subscales ($\alpha \geq 0.70$; Costa et al., 2016). Cronbach Alpha for this study was 0.90.

Data Analysis

Preliminary, descriptive, and correlation analyses were conducted using SPSS 26.0. Preliminary analyses comprised assessment of out-of-range values, missing data, univariate and multivariate normality, and reliability. Two-step structural equation modelling (Anderson & Gerbing, 1988) was conducted in AMOS 26.0. Maximum likelihood estimation was used to assess the goodness of fit and model parameters. The measurement model included six interrelated latent variables: self-oriented perfectionism, socially prescribed perfectionism, basic psychological need satisfaction, basic psychological need thwarting, introjected regulation, and exercise dependence. Exercise dependence was indicated by its seven subscales and introjected regulation was indicated by its four respective items. Three random parcels of items in respective subscales were used as indicators for all other latent variables in the model (Matsunaga, 2008). These composite approaches were employed to reduce the number of parameters in the model while still enabling calculation of a model that accounted for measurement error. Following assessment of the measurement model via confirmatory factor analyses, the hypothesized structural relationships were assessed. Conventional criteria (Marsh et al., 2004) were used as approximate markers of acceptable (χ^2/df ratio < 3.00, IFI and CFI > 0.90, RMSEA < 0.08) and excellent (χ^2/df ratio < 2.00, IFI

and $CFI > 0.95$, $RMSEA < 0.06$) model fit. Specific indirect effects along with 95% confidence intervals were calculated in AMOS 26.0 as the product of the predictor-mediator (a) and mediator-criterion (b) parameters (Preacher & Hayes, 2008). Significant indirect effects were denoted by 95% confidence intervals that excluded zero (Preacher & Hayes, 2008; Table 1).

Results

Preliminary Analyses, Descriptive Statistics, and Bivariate Correlations

All values were within the expected range for the respective items. Five participants had more than 5% missing data and were removed. Subsequently, trivial amounts of missing data were evident for 146 participants (range 1–4 missing items, $M = 1.04$, $SD = 0.31$). Given the small amount of missing data, missing items were replaced by the means of non-missing subscale items for each participant (Graham, 2003). Twenty-four participants were removed due to univariate scores that deviated significantly from the normal range ($z \pm 3.29$, $p < 0.001$). Subsequently, no values exceeded Kline's (2011) cut offs for absolute skewness (< 3) and absolute kurtosis (< 10). Mahalanobis distance: $\chi^2(23) = 49.73$, $p < 0.001$, indicated five multivariate outliers which were removed. On completion of screening, $n = 223$ participants were retained for the main analyses.

On average, based on the subscale range, participants reported moderate levels of self-oriented perfectionism ($M = 4.36$, $SD = 1.32$), low-to-moderate levels of socially prescribed perfectionism ($M = 2.55$, $SD = 1.17$), high levels of need satisfaction ($M = 5.78$, $SD = 0.60$), low levels of need thwarting ($M = 1.70$, $SD = 0.68$), and moderate levels of introjected regulation ($M = 3.46$, $SD = 0.96$) and exercise dependence ($M = 3.41$, $SD = 0.80$).

Following Cohen et al.'s (2003) markers of effect size (small $r > 0.10$, medium $r > 0.30$, large $r > 0.50$), bivariate correlations revealed significant medium positive relationships between SOP and SPP ($r = 0.43$, $p < 0.001$), SOP and exercise dependence ($r = 0.31$, $p < 0.001$), and introjected regulation and exercise dependence ($r = 0.46$, $p < 0.001$). Significant small positive relationships were evident between SOP and needs satisfaction ($r = 0.18$, $p < 0.01$), SOP and introjected regulation ($r = 0.25$, $p < 0.001$), SPP and needs thwarting ($r = 0.28$, $p < 0.001$), SPP and introjected regulation ($r = 0.26$, $p < 0.001$), SPP and exercise dependence ($r = 0.21$, $p < 0.01$), needs satisfaction and exercise dependence ($r = 0.15$, $p < 0.05$), and needs thwarting and exercise dependence ($r = 0.23$, $p < 0.001$). A significant small negative relationship was evident between needs satisfaction and needs thwarting ($r = -0.19$, $p < 0.05$).

Structural Equation Modelling

Confirmatory factor analyses indicated acceptable-to-excellent fit for the measurement model: χ^2/df ratio = 1.75, $CFI = 0.93$, $IFI = 0.93$, $RMSEA = 0.06$ (90% $CI = 0.05$ to 0.07). Composite reliabilities (ρ_c) supported the measurement model: SOP = 0.83; SPP = 0.83; needs satisfaction = 0.89; needs thwarting = 0.86; introjected regulation = 0.82; exercise dependence = 0.82. Structural equation modelling indicated acceptable-to-excellent fit for the hypothesized model: $\chi^2/df = 1.75$, $CFI = 0.93$, $IFI = 0.93$, $RMSEA = 0.06$ (90% $CI = 0.05$ to 0.07). Overall, the model explained 34% variance in exercise dependence. Parameters are displayed in Fig. 1.

Table 1 Means and standard deviations of demographic information of participants

Variable	Recreational		Club		District		County		Region		Country	
	Male (n=36)	Female (n=72)	Male (n=41)	Female (n=39)	Male (n=9)	Female (n=4)	Male (n=3)	Female (n=6)	Male (n=1)	Female (n=1)	Male (n=3)	Female (n=3)
Age	44.05 ± 11.79	42.76 ± 9.71	44.41 ± 13.28	40.43 ± 12.15	38.33 ± 6.48	46.75 ± 15.20	38.40 ± 19.11	30.17 ± 15.03	19	58	33 ± 23.43	43 ± 26.51
Hours trained	5.19 ± 3.85	4.27 ± 2.73	5.28 ± 3.90	4.56 ± 2.61	9.56 ± 9.96	5.50 ± 4.36	4.30 ± 2.49	6.50 ± 5.17	8	10	9.33 ± 3.06	8.33 ± 5.77
SOP	4.42 ± 1.42	4.13 ± 1.33	4.56 ± 1.35	4.45 ± 1.35	5.44 ± 1.19	5.05 ± 1.55	4.40 ± 0.53	4.87 ± 1.12	4.8	4.2	5.20 ± 1.22	4.29 ± 1.33
SPP	2.45 ± 0.98	2.64 ± 1.31	2.37 ± 1.08	2.81 ± 1.30	3.04 ± 0.84	2.25 ± 0.82	2.27 ± 0.31	3.27 ± 1.38	2.6	2.8	2.87 ± 2.01	2.87 ± 1.51
Introjected	3.28 ± 1.05	3.53 ± 0.96	3.31 ± 1.06	3.58 ± 0.97	3.83 ± 3.25	3.25 ± 0.41	2.67 ± 0.88	3.80 ± 1.23	3.5	3.5	3.5 ± 1.30	3.55 ± 0.95
Needs satisfaction	5.67 ± 0.64	5.60 ± 0.72	5.98 ± 0.65	5.72 ± 0.57	5.75 ± 0.82	5.83 ± 0.25	4.98 ± 1.48	6.05 ± 0.61	5.9	6.4	5.17 ± 0.44	5.94 ± 0.11
Needs thwarting	1.61 ± 0.59	1.81 ± 0.78	1.74 ± 0.77	1.75 ± 0.78	2.31 ± 0.93	1.33 ± 0.51	2.58 ± 1.29	1.44 ± 0.44	2.66	1.5	2.81 ± 0.76	3.22 ± 1.35
Exercise dependence	74.46 ± 17.16	68.97 ± 14.79	70.41 ± 17.03	68.97 ± 14.79	83.11 ± 19.83	68.00 ± 9.09	68.66 ± 15.50	77.50 ± 26.07	78	80	81.67 ± 8.39	93.00 ± 9.00

SOP= self-oriented perfectionism; SPP = socially prescribed perfectionism; Hours trained= hours spent training per week ± denotes standard deviation

Test of Indirect Effects

Bootstrapped indirect effects with 95% bias-corrected confidence intervals are displayed in Table 2. We utilized bootstrapped indirect effects with bias-corrected confidence intervals as this approach provides a powerful and robust calculation of indirect effects when testing multiple mediators (Preacher & Hayes, 2008). A significant positive indirect effect was found for SPP on exercise dependence via needs thwarting and introjected regulation. All other indirect effects were non-significant.

Discussion

The aim of our study was to examine the multidimensional perfectionism-exercise dependence relationship, and whether needs satisfaction, needs thwarting and introjected regulation mediated these relationships. The hypothesized model explained a large proportion of variance in exercise dependence. In line with our hypotheses, we found significant positive SOP-exercise dependence and SPP-exercise dependence relationships. Further, we found that the SPP-exercise dependence relationship was mediated by needs thwarting and introjected regulation. Contrary to our hypotheses, neither basic psychological need thwarting, nor introjected regulation mediated the SOP-exercise dependence relationship.

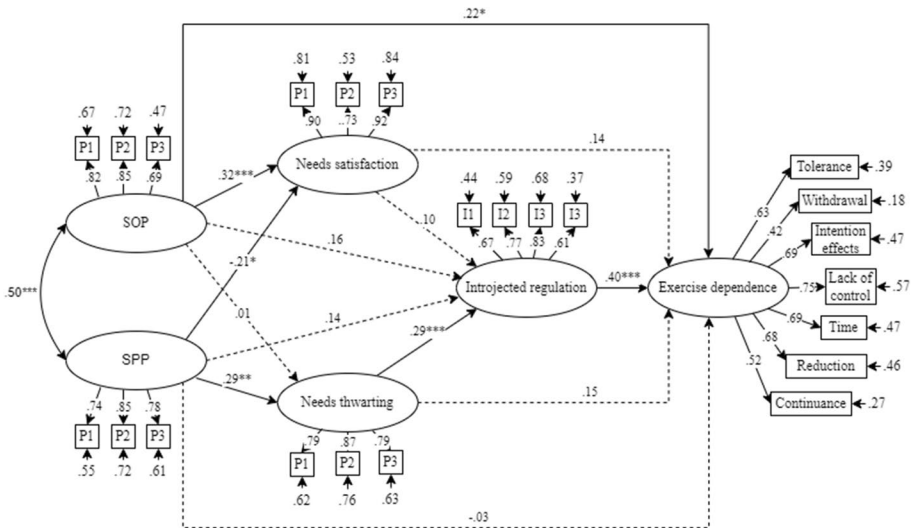


Fig. 1 Structural equation model of the relationships between perfectionism and exercise dependence and the mediating influence of need satisfaction, need thwarting and introjected regulation. All pathways are standardized. All parcel and indicator parameters were significant $p < .001$. SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; P = parcel; I = indicator. Dashed line ns, * $p < .05$ ** $p < .01$, *** $p < .001$

Table 2 Specific indirect effects of perfectionism dimensions on exercise dependence via basic psychological needs and introjected regulation

	Specific indirect effect (SE)	95% CI lower bound	95% CI upper bound	<i>p</i>
SOP–NS–ED	.021 (.016)	.000	.064	.053
SOP–NT–ED	.001 (.007)	–.010	.020	.743
SOP–IJ–ED	.030 (.022)	–.004	.086	.084
SOP–NS–IJ–ED	.006 (.006)	–.002	.025	.152
SOP–NT–IJ–ED	.001 (.005)	–.009	.013	.839
SPP–NS–ED	–.012 (.011)	–.046	.000	.056
SPP–NT–ED	.017 (.015)	–.002	.062	.078
SPP–IJ–ED	.025 (.019)	–.003	.074	.075
SPP–NS–IJ–ED	–.004 (.005)	–.018	.001	.143
SPP–NT–IJ–ED	.015 (.009)	.005	.042	.002

SOP = self-oriented perfectionism; SPP = socially prescribed perfectionism; IJ = introjected regulation; NS = need satisfaction; NT = need thwarting; ED = exercise dependence

Multidimensional Perfectionism and Exercise Dependence

Our findings suggest that SOP and SPP are positively associated with exercise dependence, with SOP sharing a relatively larger relationship. Therefore, the self-imposed, relative to other-imposed, pursuit of perfection appears most proximal to excessive exercise. This mirrors previous studies where SOP has typically been a stronger predictor of exercise dependence (e.g., Bircher et al., 2017). More specifically, Hill et al. (2015) found SOP to be significantly positively associated with the symptoms of exercise dependence (all except *Reduction*). In contrast, SPP only showed significant associations (both positive) with symptoms of *Reduction* and *Intention Effects*. Moreover, this reflects a broader theme of perfectionism and addiction research, where researchers have found that compared to SPP, SOP tends to share stronger direct relationships with other forms of behavioral addiction (e.g., work addiction; Kun et al., 2020). Taken together, our findings add to the growing evidence that SOP represents the most salient perfectionism vulnerability factor in relation to exercise dependence.

The Mediating Role of Basic Psychological Needs and Introjected Regulation

We found that needs thwarting and introjected regulation mediated the SPP-exercise dependence relationship. Specifically, SPP was positively associated with needs thwarting, which in turn was associated with introjected regulation, which in turn was associated with exercise dependence. To our knowledge, this is the first time that the relationship between perfectionism and exercise dependence has been explained from an encompassing SDT perspective. In highlighting these mediation effects, our findings build on the study by Costa et al. (2016) in two ways. First, they highlight that introjected regulation as well as needs thwarting are important components when considering the motivational signature of exercise dependence for socially prescribed perfectionists. Second, they suggest that these components of SDT mediate the relationship between interpersonal dimensions of perfectionistic concerns (SPP) and exercise dependence, as well as the intrapersonal dimensions (concern over mistakes, doubts about actions) highlighted in Costa et al. (2016).

Contrary to our hypotheses, neither basic psychological needs (satisfaction/thwarting), nor introjected regulation mediated the SOP-exercise dependence relationship. As evidenced here and in previous studies (e.g., Appleton & Hill, 2012), SOP is motivationally complex. In our model SOP shared positive relationships with needs satisfaction but also a small positive relationship with introjected regulation. However, the pathway to exercise dependence via these motivational mediators was non-significant. This might simply be because SOP shares a more direct relationship with exercise dependence than other dimensions of perfectionism. Alternatively, this may allude to other more salient explanatory mechanisms. For instance, it may be that the tendency for self-oriented perfectionists to link self-worth to exercise achievement represents a clearer signature of the SOP-exercise dependence relationship (see Hall et al., 2009).

Practical Implications

Our findings suggest that distance runners and running coaches could consider their provision of basic psychological needs support. For example, coaches could employ an autonomy supportive style where they provide choice, encourage problem-solving, and refrain from harshly criticizing their runners. Doing so may be particularly beneficial for distance runners of a high socially prescribed perfectionistic nature who demonstrate exercise dependence. Further, in line with our work here and previous studies (e.g., Hall et al., 2009) promoting a view of running as an enjoyable and healthy pursuit, avoiding priming guilt for not going running (or for engaging in reduced amounts of exercise), and actively discouraging exercise as a means by which to measure self-worth may benefit self-oriented and socially prescribed perfectionist runners.

Limitations and Future Research Directions

There are some limitations to our study. First, the use of a cross-sectional design means the causal sequence of the mediation effects is yet to be established. Future longitudinal and experimental investigations are therefore required to examine the mediating effects of basic psychological needs and motivational regulation on perfectionism-exercise dependence relationships. In addition, the subjective measures we employed are open to social desirability bias. For example, there may be a risk for exercisers participating in a study about exercise dependence to underreport their actual dependency on exercise, or alternatively overreport in circumstances where high volumes of exercise are the social norm (e.g., running clubs). Therefore, in future researchers could consider objective measures (e.g., physiological markers of fatigue), alongside subjective measures to provide a more holistic understanding of exercise dependence. Another future direction would be to build on the present and Miller and Mesagno's (2014) studies by examining potential moderators of the perfectionism-exercise dependence relationship. Some fruitful avenues for this line of enquiry include other personality factors, as well as components housed within SDT that have previously been shown to buffer the maladaptive influence of perfectionism (e.g., autonomy support; Jowett et al., 2021). Although gender was not a primary focus for our study, in future researchers may wish to examine gender differences in perfectionism and exercise dependence to build on previous findings demonstrating higher levels of exercise dependence in male exercisers (Dumitru et al., 2018). Finally, examination of group contagion of perfectionism and exercise dependence amongst running clubs may be of

interest for future studies as this could provide an opportunity to research OOP with exercise dependence.

Conclusion

In conclusion, the results from our study provide initial evidence that a combination of basic psychological needs thwarting and introjected regulation mediate the relationship between SPP (as conceived by Hewitt & Flett, 1991a, 1991b) and exercise dependence. Furthermore, our findings add to the growing body of evidence showing SOP as a stronger direct predictor of exercise dependence, relative to SPP.

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Declarations

Ethics Approval All procedures followed were in accordance with the ethical standards of the authors' institutional research ethics committee regarding human experimentation and with the Helsinki Declaration of 1975, as revised in 2000.

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

Conflict of Interest The authors declare no competing interests.

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