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short communication

Perfectionism and performance in sport: Exploring non-linear relationships with track and field athletes

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ABSTRACT

The relationship between perfectionism – perfectionistic strivings and perfectionistic concerns – and athletic performance is contested and inconsistent. The present study explored the possibility that one explanation for this inconsistency is the assumption that the relationship is linear. In two samples, we tested alternative non-linear relationships between perfectionism and real-world competitive athletic performance. Sample one comprised 165 Swedish track and field athletes (57 % competing in female category, 42 % in male category; $M_{age} = 16.93$ years) and sample two comprised 157 British track and field athletes (55 % competing in female category, 43 % in male category; $M_{age} = 18.42$ years). Testing for linear and non-linear relationships, we found a quadratic effect whereby higher perfectionistic strivings had both positive increasing (i.e., U-shape; sample 1) and positive decreasing (i.e., inverted U-shape; sample 2) relationships with performance. We conclude that there may be circumstances when perfectionistic strivings contribute to better and worse sport performance, and that this relationship can be curvilinear.

The factors that affect performance in sport are of great interest to athletes, coaches, and audiences alike. Psychological features such as commitment, a drive to improve, and a restless "will to win" are all relevant in this regard. As such, characteristics that seemingly reflect these features, such as perfectionism, are an important focus of work seeking to understand athlete success. But whether perfectionism, in particular, supports or undermines athlete performance is contested and research has provided mixed findings. The mixed findings are likely to be partly because of methodological differences between studies but also because of some of the assumptions being made about the perfectionism-performance relationship. With this in mind, this study provides the first test of whether that relationship may, in some instances, be non-linear rather than linear. We explored this novel and alternative possibility using multiple samples of track and field athletes and testing for different types of curvilinear effects.

1. Perfectionism

Perfectionism is a multidimensional characteristic that comprises excessively high performance standards accompanied by overly critical evaluations of behaviour (Frost et al., 1990). While numerous different models of perfectionism have been developed, it is typically considered to comprise two higher-order dimensions: perfectionistic strivings (PS) and perfectionistic concerns (PC; Stoeber & Otto, 2006). PS include setting high personal standards and striving for perfection. In contrast, PC comprise concerns over making mistakes, socially prescribed pressures, and negative reactions to imperfection (Stoeber & Otto, 2006). These two dimensions act upon each other to give rise to a range of different outcomes that influence adjustment and performance in a range of settings.

Several narrative, systematic, and meta-analytical reviews summarise research on perfectionism in sport (e.g., Hill et al., 2018). Collectively, these offer a complex picture of two positively related dimensions of perfectionism (PS and PC) that can interact yet have opposing effects. The evidence relating to PC is relatively clear, indicating that it is associated with problems for athletes' motivation and wellbeing. At the same time, studies have often found PC to be unrelated to athletic performance (e.g., Lizmore et al., 2019; Waleriańczyk & Stolarski, 2021). The evidence relating to PS is yet more ambivalent, with positive, negative, and neutral effects for athletes' motivation and wellbeing. In

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addition, PS have often been found to be positively related to athletic performance (e.g., Lizmore et al., 2019; Waleriańczyk & Stolarski, 2021). This particular finding is counter to the notion that perfectionism holds few benefits to athletes (see Flett & Hewitt, 2014).

2. Perfectionism and performance

In examining the research into perfectionism and sport performance, it soon becomes clear that studies vary in their approach to studying the relationship. For instance, researchers have included different types of participants (e.g., students vs. athletes), sports (e.g., team vs. individual), ways of operationalising performance (e.g., running times vs. self-rated performance data) and tasks (e.g., laboratory tasks vs. "real world" competition performance). All of these factors have likely contributed to the inconsistent findings that are characteristic of this area and to the sense that we are some way short of knowing if, how, and why dimensions of perfectionism influence athlete performance (Hill, 2023). Inconsistent findings have also contributed to disagreement regarding the role perfectionism is likely playing in helping or hindering athletes perform at their best and fulfil their potential (see Hill, 2018; Rees et al., 2016).

Against this backdrop, the current study sought to build on research examining perfectionism and athletic performance by (1) focusing on athletes (as opposed to students) and (2) "real-world" athletic performance (as opposed to contrived tasks or tasks that may have less ecological validity). Very few studies have done so even though studies of this kind are best placed to address questions of perfectionism and sport performance (e.g., Stoeber et al., 2009). We chose to do so in a sport that lends itself especially well to performance measurement, namely track and field (athletics). Specifically, in this sport competitive performance results can be converted to a common metric using established methods (IAAF, 2017). This enables performance in a range of athletics events (e.g., running, jumping events) to be captured in a single number and compared across people and time.

Besides differences in design, there are plausible theoretical explanations as to why research has produced mixed findings for the perfectionism-performance relationship. A notable feature of research so far is the assumption that the relationship is linear. The assumption of linear relationships in sport and exercise psychology, generally, was discussed by Ivarsson and Johnson (2014) who questioned how realistic it was and provided illustrative examples of non-linear effects for coach support, mood, and wellbeing. In line with these suggestions, Nordin-Bates and Kuylser (2021) recently suggested the possibility of non-linear effects for perfectionism; that PS may be helpful up to a certain point (contributing to goal setting and diligence) beyond which it may become problematic (contributing to unrealistic goals, overtraining, and injury).

In support of this possibility, non-linear effects of PS have been observed in other contexts and for other outcomes such as creativity (Wigert et al., 2012) and health (Molnar et al., 2012). Specifically, these research groups found non-linear (quadratic) relationships between perfectionistic strivings and creativity for university students (Wigert et al., 2012) and between self-oriented perfectionism and health indicators in a sample of women with fibromyalgia (Molnar et al., 2012). These types of relationships are rarely tested in sport and exercise psychology and, as yet, have not been tested in research examining perfectionism and performance in athletes. However, they have substantive implications for our understanding of the role of perfectionism and, ultimately, how we advise coaches and support athletes in their quest for performance improvement.

3. Aims of present study

With the aforementioned studies in mind, the aim of the present study was to explore the possibility of nonlinear relationships between perfectionism and performance in sport for the first time. We did so by measuring perfectionism – PS and PC – in two samples of track and field athletes and then testing for nonlinear relationships (quadratic and cubic) with competitive performance.

4. Method

4.1. Participants

Sample 1 were 165 track and field athletes with a mean age of 16.93 years (SD = 1.28) recruited from athletics clubs in Sweden. Sixty-nine competed in the male category and 94 in the female category [2 respondents did not provide this information]). They reported having competed for an average of 6.47 years (SD = 2.86) and trained on average 10.49 h/week (SD = 3.43). Sample 2 were 157 track and field athletes (68 competing in the male category, 86 in the female category; 3 missing) with a mean age of 18.42 years (SD = 3.78) recruited from clubs in the UK. They reported having competed for an average of 6.36 years (SD = 2.65) and trained on average 9.28 h/week (SD = 5.69).

5. Procedure

The study was approved by the relevant ethics committees, and informed consent was obtained from all participants. Athletes from Sample 1 completed demographic and perfectionism measures during one of six track and field competitions, and their self-reported personal best performance and subsequent event performance was recorded. Sample 2 athletes completed the same measures at training and provided details to link their data to a competition performance website (thepowerof10.info) from which we analysed two performances to mirror sample 1 (Time 1 and Time 2, set two weeks apart). Performance data was collated in July 2021. All performances (personal best and competition performance[s]) were converted to a common metric using the IAAF conversion formula (IAAF, 2017).[1]

5.1. Measures

Perfectionism. To maximize validity and reliability, we followed recommendations to use a multi-measure approach for capturing perfectionism by using six subscales from the three most favourably reviewed measures of perfectionism in sport (Stoeber & Madigan, 2016): the Performance Perfectionism Scale-Sport (PPSS; Hill et al., 2016), the Sport Multidimensional Perfectionism Scale (SMPS; Dunn et al., 2006) and the Multidimensional Inventory of Perfectionism in Sport (MIPS; Stoeber et al., 2007). Swedish athletes completed Swedish language versions and English athletes completed English language versions. For all measures, participants were asked to indicate to what degree each statement characterised them in their sport, responding on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Higher scores indicate higher levels of perfectionism.

To measure PS, we used three indicators: the 4-item PPSS subscale capturing self-oriented perfectionism (e.g., "I put pressure on myself to perform perfectly"), the 7-item SMPS subscale capturing personal standards (e.g. "I have extremely high goals for myself in my sport") and the 5-item MIPS subscale capturing striving for perfection ("I strive to be as perfect as possible").

To measure PC, we used another three indicators: the 4-item PPSS subscale capturing socially prescribed perfectionism (e.g., "People always expect my performances to be perfect"), the 8-item SMPS subscale capturing concern over mistakes ("People will probably think less of me if I make mistakes in competition") and the 5-item MIPS subscale capturing negative reactions to imperfection ("I feel extremely stressed

[1] The data from Sample 2 presented here is a subset of a dataset with a greater number of timepoints. For the present study, we opted for the most complete dataset available so as to maximize statistical power and provide comparable data to Sample 1.

Table 1
Descriptive statistics, bivariate correlations, and omega (sample 1 and sample 2).

	Sample 1				Sample 2			
Variable	1	2	3	4	1	2	3	4
1. Perfectionistic strivings								
2. Perfectionistic concerns	.83*				.63*			
3. Personal best/Performance Time 1	.08	.08			.15	.03		
4. Event performance/Performance Time 2	.05	.04	.93*		.12	−.03	.83*	
M	−.01	−.01	768	733	−.00	−.00	765	775
SD	.85	.79	129	130	.80	.81	186	175
Omega	.82	.70	–	–	.72	.74	–	–

Note. Sample 1 $N = 131$; Sample 2 $N = 108$; Perfectionistic strivings and perfectionistic concerns are composites of standardised scores (see Method for details). PB = Personal best. *$p < .001$.

Table 2
Summary of multiple regression analyses predicting performance.

	Sample 1		Sample 2	
Criterion: Performance	R^2 .87**	β / *B* (*p*)	R^2 .86**	β / *B* (*p*)
Personal best/Time 1 performance		.91** / 0.92 (< .001)		.91** / 0.90 (< .001)
Perfectionistic strivings		.01 / −1.01 (.94)		.06 / 12.65 (.44)
Perfectionistic strivings ^2		.12* / 18.11 (.01)		−.10* / −21.25 (.04)
Perfectionistic strivings ^3		−.01 / -0.56 (.91)		−.10 / −10.47 (.19)
Perfectionistic concerns		−.09 / −14.80 (.29)		.05 / 10.23 (.57)
Perfectionistic concerns ^2		−.08 / −15.16 (.09)		.01 / 2.67 (.76)
Perfectionistic concerns ^3		.09 / 8.72 (.27)		−.10 / -9.85 (.22)

Note. Sample 1 $N = 131$, Sample 2 $N = 108$. β = standardised regression weight. ^2 = quadratic. ^3 = cubic.
*$p < .05$. **$p < .001$.

screening for outliers, one participant from Sample 1 was removed on the basis of Mahalanobis distance (a multivariate outlier). After excluding those without performance data, the sample size for Sample 1 was $N = 131$ and for Sample 2 $N = 108$.[2]

6. Results

6.1. Descriptive statistics and bivariate correlations

PS and PC were very strongly correlated, as were personal best and actual performance (Sample 1), and Time 1 and Time 2 performance (Sample 2; see Table 1). We found no other significant correlations.

6.2. Regression analyses

For Sample 1 (see Table 2)[3] we entered personal best, PS and PC and their quadratic and cubic functions simultaneously into the regression to predict performance. Results showed that the model explained 87 % of the variance in performance. Personal best emerged as a large positive predictor of performance. The quadratic function of PS was a significant yet small positive predictor. No other statistically significant predictors were found in the model (PS or PC). To understand the quadratic

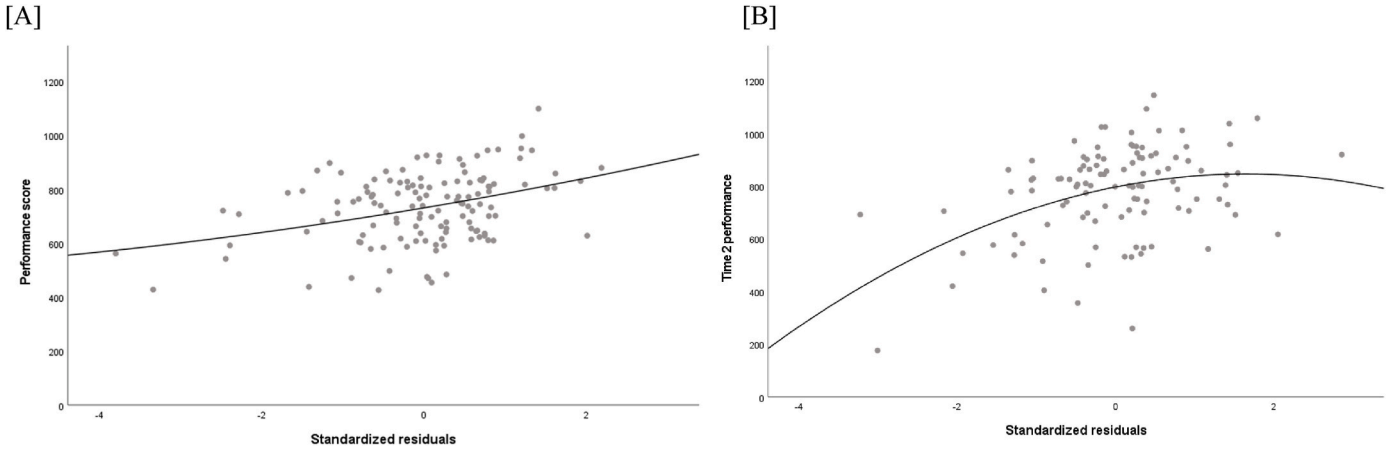

Figure 1. Figures illustrating quadratic effects for Sample 1 [A] and Sample 2 [B].

if everything does not go perfectly"). All perfectionism scores were standardised before being combined into a composite measure of PS and PC, respectively (cf. Watson et al., 2021).

5.2. Data screening

Very few item responses were missing (Sample 1, 17 individual items; Sample 2, 21 individual items), and so missing responses were replaced with the mean of the responses of the corresponding scale (ipsatised item replacement; Graham et al., 2003). Omega for the questionnaire scores were all satisfactory (see Table 1 and 2). Following

[2] Sample sizes were determined by response rate to the questionnaire across a period of six competitions spanning the summer season (Sample 1) and across a comparable period of 3 months (Sample 2). No a priori power analysis was conducted. However, we were guided by recommendations of Tabachnick and Fidell (2017) and Ivarsson and Johnson (2014) as regards adequate sample sizes for regression and curvilinear effects.

[3] Gender and age were not correlated with performance in either sample, neither did they emerge as significant predictors in separate regression analyses.

function of PS further, we plotted performance against standardised residuals from the model, and added a quadratic function to this plot (see Figure 1).

For Sample 2, we entered Time 1 performance, PS and PC and their quadratic and cubic functions simultaneously into the regression to predict next subsequent performance (Time 2; see Table 2). Results showed that the model explained 86 % of the variance in performance. Time 1 performance emerged as a large positive predictor of performance. In addition, the quadratic function of PS emerged as a significant but small negative predictor of Time 2 performance. No other statistically significant predictors were found in the model (PS or PC). To understand the quadratic function of PS further, we plotted Time 2 performance against standardised residuals from the model, and added a quadratic function to this plot (see Figure 1).

7. Discussion

The aim of the present study was to explore nonlinear relationships between perfectionism and performance in sport. In doing so, we assessed whether PS and PC had nonlinear relationships with performance in two samples of track and field athletes. In both samples, we found evidence of a non-linear, quadratic, effect between PS and performance. However, the effects were different: in Sample 1, the relationship was positive and increasing whereas, in Sample 2, the relationship was positive and decreasing.

7.1. Perfectionism and performance

The relationship between perfectionism and sport performance is under-researched given the importance of performance in sport, the contentious nature of the proposed relationship, and the inconsistent findings so far. In the present study we were especially interested in the idea that PS may be conducive to athlete performance up to a certain point but problematic thereafter. In testing this possibility, we found the first evidence of a non-linear effect consistent with this assertion. For some athletes (Sample 2), it appears that PS is initially related to better athletic performance but the advantages decline and PS eventually begins to exert a negative effect on performance (i.e., an inverted U-shaped relationship). As such, our findings support the suggestion of such an effect in dance (Nordin-Bates & Kuylser, 2021), and are similar to work on perfectionism and creativity and health outcomes (Molnar et al., 2012; Wigert et al., 2012).

We also found, unexpectedly, that the usefulness of PS for performance *increased* for Sample 1, with higher rates of change evident for the highest PS scores (a U-shaped relationship). While this contrasts with our Sample 2 findings, it is illustrative of alternative nonlinear relationships that have not previously been considered for sport performance. There is, however, recent evidence of similar effects when examining the relationship of perfectionism with work engagement (Xu et al., 2022) and helping others at work (Shoss et al., 2015). In these cases, though, effects pertained to imposing perfectionistic standards on others rather than oneself, and both effects were subject to moderation by other variables (conscientiousness and locus of control).

In speculating on reasons why we have observed these differences, there are a number of possible explanations. First, PS is a complex characteristic and there may be circumstances when its effects are positive for performance. For example, athletes higher in PS might set more ambitious goals, put forth great effort, and generally self-regulate in ways less committed athletes would not (e.g., Hewitt & Flett, 2014; Nordin-Bates & Kuylser, 2021). At the same time, PS has long been suggested to be a vulnerability factor for performance problems, particularly under conditions of stress and setbacks (Flett & Hewitt, 2005), and research in sport has provided at least some evidence that this may be the case (e.g., Curran & Hill, 2018). Our different findings may also be due to methodological factors. For example, the samples were drawn from two different countries and completed different versions of the same questionnaire (Swedish and English versions) so there may be subtle differences in interpretation. Research examining cultural differences in perfectionism in sport is in short supply but will be needed to explore these possibilities further. Finally, future research might wish to consider any possible impact of factors that we did not capture such as competition relevance, season timing, and potential differences between athletics disciplines. For example, runners compete together and so may be more affected by their competitors than athletes who compete separately (e.g., throwers).

Despite the inconsistent findings regarding non-linear effects, we consider this study to contribute to the literature in at least three ways. First, it highlights that the relationship between PS and athletic performance is more complex than has been studied so far, because existing research has assumed a linear relationship. Second, the possibility of a nonlinear relationship appears to extend beyond the notion that PS may be beneficial at lower levels but problematic at higher levels; instead, PS may display several different non-linear effects with performance. Third, we have observed different non-linear effects even with similar samples, sports, and ways of operationalising perfectionism and performance. As such, there must be other moderating factors that may explain why similar sets of circumstances produce such different effects. Future research is needed to identify these factors.

Beyond PS, the present study showed that PC appears to be less relevant to athletic performance, having neither a linear nor non-linear relationship with performance. This is consistent with previous research which has typically shown PC to be a non-significant predictor of performance when examined linearly (Hill et al., 2018). As such, there is to date little evidence that PC (e.g., athletes' concerns over mistakes and negative reactions to imperfection) impact performance. Caution is warranted, however, because PC are often linked to other kinds of problematic outcomes that may do so (e.g., anxiety, injury, burnout; Hill et al., 2018). In this regard, the relationship may be indirect and subject to moderation.

8. Conclusion

If, how, and why perfectionism is related to athlete performance remain important unresolved questions. With the current study, we have provided the first evidence of non-linear relationships between athlete perfectionism and performance. Future research into this relationship, ideally including moderating variables, needs to more routinely examine these types of effects and how they occur.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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