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Perfectionistic Tipping Points: Re-Probing Interactive Effects of Perfectionism

Andrew P. Hill

York St John University, UK

Author note

Andrew P. Hill, School of Science, Technology, and Health, York St John University

Correspondence concerning this article should be addressed to School of Science, Technology, and Health, York St John University, Lord Mayor's Walk, York, YO31 7EX, UK.

E-mail: a.hill@yorksj.ac.uk

Abstract

Researchers have recently turned their attention to examining interactive effects of dimensions of perfectionism in sport and exercise. This is typified by research testing the 2 × 2 model of perfectionism (Gaudreau & Thompson, 2010) and the use of simple slopes analysis to probe statistically significant interactions. The aim of this study is to illustrate a different approach to probe statistically significant interactions, the Johnson-Neyman (J-N) technique, and how it can identify the specific level of evaluative concerns perfectionism at which the effect of personal standards perfectionism changes (termed the perfectionistic tipping point). To meet this aim, secondary analysis was undertaken of three samples that previously provided evidence of interactions between dimensions of perfectionism in predicting sport devaluation, dedication, enthusiasm, and expressive suppression. Using the J-N technique, perfectionistic tipping points were identified whereby the conditional effect of PSP became statistically significant for each outcome at low-to-moderate levels of ECP. In each case, the level of ECP was outside of the levels tested in the 2 × 2 model making it useful complementary information. Based on the findings, it is recommended that researchers report perfectionistic tipping points when probing significant interactions in the 2 × 2 model of perfectionism and when examining interactive effects of perfectionism, generally.

Keywords: Perfectionism, Moderation, Interaction

Introduction

One of the recent changes in the study of perfectionism has been a shift from examining independent or main effects of dimensions of perfectionism to examining their interactive effects. This change has helped move researchers towards a more valid account of the likely effects of perfectionism. One approach that has become synonymous with testing interactive effects is the 2 × 2 model of perfectionism (Gaudreau & Thompson, 2010). This model has been an important advancement in the way perfectionism is studied and has improved our understanding of perfectionism in sport and exercise. In the present study, an approach is illustrated that can help researchers interested in how dimensions of perfectionism interact garner additional information when probing significant interactions in this model and generally. Here, this approach is represented conceptually and statistically through the identification of a "perfectionistic tipping point". That is, the level of evaluative concerns perfectionism at which the effects of personal standards perfectionism change for a given outcome.

Overview of the 2 × 2 Model of Perfectionism

As described by Gaudreau and colleagues (Gaudreau & Thompson, 2010; Gaudreau, 2012, 2013), the 2 × 2 model of perfectionism focuses on the examination of different combinations of dimensions of perfectionism. This can either be broad dimensions of perfectionism, referred to as evaluative concerns perfectionism (ECP) and personal standards perfectionism (PSP), as well as sub-dimensions of perfectionism from other models (see Stoeber & Madigan, 2016). In the 2 × 2 model, dimensions are combined in a manner that captures four within-person combinations or subtypes of perfectionism; non-perfectionism (low PSP/low PSP), pure PSP (high PSP/low ECP), pure ECP (low PSP/high ECP) and mixed perfectionism (high PSP/high ECP). With non-perfectionism serving as a comparative subtype, the other subtypes are

on a continuum of internalization reflecting the degree to which the perfectionistic standards are derived from the self and are likely less problematic (pure PSP) to being derived externally and likely more problematic (pure ECP).

The 2 × 2 model is formally tested via a set of four hypotheses that pertain to expected differences between the four subtypes of perfectionism. These hypotheses are based on the theoretical differences between PSP and ECP, and their configuration within each subtype. Hypothesis 1 is multipronged and allows for the possibility that pure PSP is better (1a), worse (1b), or comparable (1c) to non-perfectionism. Gaudreau and Thompson (2010; Gaudreau, 2012) argue that the three versions of Hypothesis 1 are desirable so to provide a comprehensive account of the possible effects of pure PSP. Note, however, that even support for hypothesis 1a should not be used as evidence that perfectionism is desirable (see Gaudreau, 2018).[1] Hypothesis 2 states that pure ECP is associated with the worst outcomes (ascertained via comparison to non-perfectionism). Hypothesis 3 states that mixed perfectionism is associated with better outcomes than pure ECP. Finally, hypothesis 4 states that mixed perfectionism is associated with poorer outcomes than Pure PSP.

The development of the 2 × 2 model has been a clear advancement to the study of perfectionism for several reasons. As described by others (e.g., Gaudreau & Thompson, 2010;

[1] Gaudreau (2018) has recently introduced the concept of excellencism and how this might be used to better understand the effects of PSP with the idea that such a comparison would reveal that PSP is associated with increasing returns (i.e., PSP > excellencism), diminishing returns (i.e., PSP = excellencism), or decreasing returns (i.e., PSP < excellencism). Readers are directed to Gaudreau (2018) for more information on this work.

Gaudreau, 2013; Hill & Madigan, 2017), it promotes the examination of combined, interactive, and suppressive effects of dimensions of perfectionism, accommodates different models of perfectionism, and includes a priori hypotheses. In comparison to other approaches that emphasize combinations of perfectionism (viz. tripartite model, see Gotwals, 2016), it also does not have the same questionable assumptions regarding the underlying taxometric structure of perfectionism and has demonstrably more empirical support (Hill & Madigan, 2017). Finally, although the model was developed with possible interactions in mind, its hypotheses can be tested in the presence or absence of a statistically significant interaction effect (Gaudreau, 2012). As such, it is a flexible model that manages parsimony and provides consistency in how subtypes are compared across studies.

The current study focuses on instances in which a statistically significant interaction has been found and researchers are seeking to understand the nature of the interaction. This applies to the 2 × 2 model of perfectionism but also to probing significant interactions between PSP and ECP generally. The 2 × 2 model of perfectionism has been selected as the context in which to illustrate what additional information can be learned when probing interactions as it is a touchstone for researchers in this area. It is also the model that has uncovered a number of significant interactions in perfectionism research in sport and exercise. The approach illustrated is the Johnson-Neyman (J-N) technique (Johnson & Neyman, 1936). It is not new to sport and exercise psychology but it remains underutilized. In addition, the J-N technique can be used to further our conceptual and practical understanding of perfectionism by providing additional information about how dimensions of perfectionism interact in producing positive, negative and neutral outcomes in sport and exercise.

Probing Statistically Significant Interactions

When testing the hypotheses of the 2 × 2 model of perfectionism, moderated regression is first used to ascertain if there is a statistically significant interaction between ECP and PSP. If the interaction effect is not statistically significant, the hypotheses of the model are tested by examining the main effects (Gaudreau, 2013). If the interaction effect is statistically significant, the hypotheses are tested using simple slopes analysis (Cohen et al., 2003). In simple slopes analysis whether the relationship between the predictor variable and the outcome variable (referred to as the conditional effect) is statistically significant at different levels of the moderator is tested (Curran & Baur, 2005). The levels of the moderator are specified by the researcher and typically follow common recommendations to examine high (plus one standard deviation) and low levels (minus one standard deviation) of the mean of the moderator (e.g., Aiken & West, 1991).

As a technique for probing significant interactions, generally, simple slopes analysis is considered to have several weaknesses (see Curran & Baur, 2005; Rogosa, 1981). Notably, in selecting only a small number of values of the moderating variable at which to examine the conditional effect, the approach excludes all other possible values of the moderating variable. This is important because it means that statistically significant conditional effects can be missed using simple slopes analysis if the conditional effect is statistically significant at levels outside of those tested. In addition, the values selected at which to test conditional effects can be considered arbitrary. That is, while they convey “high” or “low” scores within the distribution of scores, they do not typically correspond with any externally meaningful points of reference (e.g., normative scores, cut-off values or thresholds). The arbitrary values also vary in absolute terms from sample to sample depending on the level of variability that is evident and so makes comparison across studies difficult.

Simple slopes analysis provides a sufficient to test the hypotheses of the 2 × 2 model. However, thereafter, the analysis does not provide any further information regarding the interaction effect. One complimentary approach to simple slopes analysis that provides additional information is the J-N technique (Johnson & Neyman, 1936). Originally developed for examining interactions between continuous and dichotomous variables in ANCOVA, Bauer and Curran (2005) extended the technique to standard (fixed-effects) regression and multilevel (random-effects) regression. As Bauer and Curran describe, the J-N technique has two important advantages in comparison to simple slopes analysis. First, when the J-N technique is used the conditional effect is assessed across all values of the moderator. Second, accompanying confidence bands for the conditional effect can be used to provide values for the conditional effect over the range of the moderator to indicate the precision of the conditional effect. In these regards, the J-N technique has been aptly labelled a "floodlight" test whereas simple slopes analysis has been labelled a "spotlight" test (Spiller et al., 2013).

As described by Hayes (2013), there are three outcomes of the J-N technique. The first outcome is a region of significance defined by a single value of the moderator (M). This value signals either that the effect of the predictor (X) on the outcome (Y) is statistically significant when the moderator (M) is *equal to or more* than a certain value ($M \geq J\text{-}N_{M1}$) or is statistically significant when M is *equal to or less* than a certain value ($M \leq J\text{-}N_{M1}$). The second outcome is a region of significance defined by two values of M. The region of significance signals either that the effect of X on Y is statistically significant when M is *within the range* of the two values ($M \geq J\text{-}N_{M1}$ and $M \leq J\text{-}N_{M2}$) or statistically significant when M is *outside the range* of these two values ($M \leq J\text{-}N_{M1}$ and $M \geq J\text{-}N_{M2}$). The third, and final, outcome is that there are no values of M that

change the statistical significance of the relationship between X and Y. This means that the effect of X on Y is either statistically significant across the entire range of M or none of it.

Some examples of the use of the J-N technique help demonstrate the additional insight it offers and the three outcomes Hayes (2013) describes. In regards to the first outcome, when examining the effects of different types of motivational climate on athletes, Appleton and Duda (2016) found that only at the point at which athletes reported perceptions of an empowering coach climate was less than 3.14 (on a scale of 1 to 5) was a disempowering coach climate significantly related to lower enjoyment. Similarly, Reynolds and McDonough (2015) found that only at the point at individuals reported coach involvement was more than 2.19 (on a scale of 1 to 4) was coach autonomy support significantly related to higher athlete intrinsic motivation. The second outcome Hayes describes, of a region of significance defined by two values, is illustrated by Curran et al. (2013), who found that only at the point at individuals reported coach autonomy support was less than 2.43 and more that 4.50 (on a scale of 1 to 7) was the indirect effect of coach structure on athlete engagement statistically significant (with the relationship being negative at lower levels and positive at higher levels). Finally, the last outcome Hayes describes, of a region of statistical significance that spans an entire range of scores, is illustrated by Gjesdal et al. (2017) who found that athlete task orientation was significantly related to higher competence need satisfaction for all scores of athlete intrinsic motivation.

Perfectionistic Tipping Points

The current study applies the J-N technique to studying perfectionism with the aim of identifying perfectionistic tipping points. Perfectionistic tipping points are defined as the level of ECP at which the effects of PSP change for a given outcome. Two perfectionistic tipping points of especial interest are when PSP becomes ambivalent (after having been related to a positive

outcome) or problematic (after having been ambivalent or related to a positive outcome). These are examples that mark important conceptual and statistical moments when any neutral or seemingly positive qualities or benefits of PSP give way, or are subverted, by the presence of the negative qualities or drawbacks of ECP. Identification of these perfectionistic tipping points provides important additional insight regarding for whom perfectionism it is likely to be beneficial, problematic, or neither.

One recent study helps illustrate the existence and importance of perfectionistic tipping points. Lizmore et al. (2019) examined the interactive effects of PSP and ECP on athletic performance (golf putting) following competitive failure. They found that at lower levels of ECP (≤ 2.80 on a scale of 1 to 5), PSP had a statistically significant positive relationship with athletic performance. However, as ECP increased, the relationship became non-significant and was eventually reversed with PSP having a statistically significant negative relationship with athletic performance (≥ 4.53 on a scale of 1 to 5). These findings show that the relationship between perfectionism and performance are complex and it would be incorrect to conclude that athletes benefit from PSP. A more accurate conclusion given these findings would be that PSP is only likely to be beneficial for athletes in regards to performance after competitive failure if they have lower ECP and could be problematic if they have higher ECP.

It is possible that other perfectionistic tipping points exist in different contexts and for different dependent variables. With this in mind, examination of existing research highlights at least three areas where perfectionistic tipping points may be evident - athlete burnout, athlete engagement, and coach emotion regulation (Blinded for Peer Review). For athlete burnout, an interactive effect was found in a sample of junior soccer players for sport devaluation (a reduced sense of value or attachment to sport). For athlete engagement, interactive effects were found in

a sample of junior athletes for dedication (a desire to invest effort and time towards achieving personally important goals) and enthusiasm (feelings of high levels of excitement and enjoyment). And, finally, for coach emotion regulation, an interactive effect was found for expressive suppression (effort to inhibit ongoing emotion-expressive behavior). Revisiting these four interactive effects using the J-N technique will offer both additional insight into these particular relationships and provide a useful illustration of the J-N technique and perfectionistic tipping points.

Current Study

The aim of the current study is to illustrate the use of the J-N technique in probing significant interactions between dimensions of perfectionism and identifying perfectionistic tipping points. To do so, three data sets are reanalyzed from previously published research examining four outcomes (sports devaluation, dedication, enthusiasm and expressive suppression). The results of the simple slopes analysis are also reported to allow comparison of the two techniques and the complementary information they provide.

Method

Participants

Sample one were 171 junior male soccer players from soccer academies of professional football clubs (*M* age = 16.17, *SD* = 1.57). They reported that they had typically been at their club for 4.35 years (*s* = 3.06) and trained and competed for an average of 12.27 hrs per week (*SD* = 6.49).

Sample two were 222 junior athletes (*M* age = 16.01, *SD* = 2.68, 98 males and 124 females) recruited from various sports individual and team sports (e.g., football, rugby, cricket,

and swimming). Participants reported that they had been competing for 7.21 years (*SD* = 3.53) and trained and competed on average for 9.51 hrs per week (*SD* = 4.54).

Sample three were 238 sport coaches (*M* age = 23.92, *SD* = 10.32, 177 males and 61 females) recruited from sport organizations and universities. Coaches came from a range of individual and team sports (e.g., football, rugby, athletics, and swimming). On average, they had coached for 4.31 years (*SD* = 5.45) and were currently coaching 4.44 hrs per week (*SD* = 4.43).

All three samples have been used previously in published pieces of research (Blinded for Peer Review). No a priori power analysis was provided in the three original papers. Therefore, as a reference point, power analyses indicates that sample sizes between 152 to 252 would be required in order to detect ΔR^2 between .03 to .05 in hierarchical regression analyses ($\alpha = .05$, power = .80, tested predictors =1, total predictors = 3; Erdfelder et al., 1996). Research examining the 2 × 2 model of perfectionism in sport has reported a range of ΔR^2 for an interaction effect from <.010 to .046 (e.g., Crocker et al., 2014; Gaudreau & Verner-Filion, 2011; Madigan et al., 2016).

Instruments

Multidimensional perfectionism. In samples one and two, the shortened version of Hewitt and Flett's (1991) Multidimensional Perfectionism Scale (H-MPS-short; Cox et al., 2002) and Gotwals et al.'s (2010) Sport-Multidimensional Perfectionism Scale-2 (S-MPS-2) were used. From the H-MPS-short, the self-oriented perfectionism (SOP; e.g., "I set very high standards for myself") and socially prescribed perfectionism (SPP; e.g., "My family expects me to be perfect") subscales were used. These two subscales include 5 items that are scored on a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). The instruments were adapted to focus athletes on sport. From the S-MPS-2, personal standards (PS; 7 items, e.g., "I have extremely

high goals for myself in my sport"), concern over mistakes (COM; 8 items, e.g., "If I fail in competition, I feel like a failure in person"), doubts about actions (DAA; 6 items, e.g., "Prior to competition, I rarely feel satisfied with my training"), perceived parental pressure (PPP; 9 items, e.g., "My parents expect excellence from me in my sport") and perceived coach pressure (PCP; 6 items, e.g., "My coach sets very high standards for me in competition") subscales were used. Responses are scored on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). Subscales were combined so to examine higher order PSP and ECP in sample 1 (SOP and PS versus SPP, COM, DAA, PPP, and PCP) and in sample 2 (SOP and PS versus SPP, COM, and DAA).

In sample three, the SOP and SPP subscales from the shortened version of Hewitt and Flett's (1991) Multidimensional Perfectionism Scale (H-MPS-short; Cox et al., 2002) were used again. However, the short version of Frost et al.'s (1990) Multidimensional Perfectionism Scale (F-MPS-short; Cox et al. 2002) was also used. From the F-MPS-short, personal standards (PS; 5-items, e.g., "I set higher goals than most people."), concern over mistakes (COM; 5-items, e.g., "If I fail partly, it is as bad as being a complete failure."), doubts about actions (DAA; 4-items, e.g., "I usually have doubts about the simple everyday things I do."), and parental pressure (PP; 5-items, e.g., "I never felt like I could meet my parents' standards.") subscales were used. Responses are scored on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). Again, subscales were combined to examine higher order perfectionistic strivings and perfectionistic concerns (SOP and PS versus SPP, COM, DAA, and PP).

Evidence for the validity and reliability of these instruments has been provided by Cox et al. (2002) and Dunn and colleagues (Dunn et al., 2009; Gotwals et al., 2010).

Athlete Burnout. In sample one, athlete burnout was measured using the Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001). The ABQ includes three subscales that assess a reduced sense of athletic accomplishment (RA; 5-items, e.g., “My football [soccer] is really going downhill”), emotional and physical exhaustion (EE; 5-items, e.g., “I just feel like I don’t have any energy”), and sport devaluation (D; 5-items, e.g., “I’m just not in to football [soccer] like I used to be”). Responses are scored on a 5-point Likert scale (1 = *almost never* to 5 = *almost always*). Evidence for the validity and reliability of this instrument has been provided by Raedeke and Smith (2001).

Athlete Engagement. In sample two, athlete engagement was measured using the Athlete Engagement Questionnaire (AEQ; Lonsdale et al., 2007). The AEQ includes four subscales that assess confidence (CON; 4-items, e.g., “I am confident in my abilities”), dedication (DED; 4-items e.g., “I am dedicated to achieving my goals”), vigor (VIG; 4-items, e.g., “I feel really alive”), and enthusiasm (ENT; 4-items, e.g., “I feel excited about my sport”). Responses are scored on a 5-point Likert scale (1 = *almost never* to 5 = *almost always*). Evidence for the validity and reliability of this instrument has been provided by Lonsdale et al. (2007).

Emotion Regulation. In sample three, emotion regulation strategies were measured using the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). The ERQ includes two subscales that assess the use of cognitive reappraisal (CA; 6-items, e.g., “When I want to feel more positive emotion (such as joy or amusement), I change what I’m thinking about”) and expressive suppression (ES; 4-items, e.g., “I control my emotions by not expressing them”). Responses are scored on a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). Evidence to support the validity and reliability of the instrument has been provided by Gross and John (2003).

Analytical Strategy

In order to examine the moderation effects of PSP and ECP on the outcome variables, Gaudreau and Thompson's (2010) approach was followed. This included consideration of a main effects model (PSP and ECP as predictors) and an interaction effects model (PSP, ECP, and PSP*ECP as predictors) in a hierarchical manner (with PSP and ECP mean-centered prior to creating the interaction term). In the published research from which the data has been selected, significant interaction terms were probed using a pick-a-point technique (i.e., plotting the values of Y [outcome variable] predicted by X [PSP] at +/- 1 SD of the mean value Z [ECP]). In the current study, instead, the J-N technique is used to focus on regions in which the effect of X (PSP) on Y (outcome variable) is statistically significant ($p < .05$) based on scores on Z (ECP). To do so, analyses were conducted using the PROCESS macro for SPSS (version 3.4; Hayes, 2013) with the J-N technique selected as an option to probe significant interactions ($p < .05$) and the values of the conditional effect of X on Y plotted using graphical software (e.g., Excel; y-axis is the size of conditional effect and x-axis is value of Z). PSP and ECP are rescaled to a 1-to-7 response scale to mirror a typical response format.

Results

Preliminary Analyses

Before the main analyses, missing value analysis was conducted on the data. In sample one, two participants were removed from the sample due to large amounts of missing data (> 5%). There were 14 cases with incomplete data with 14 unique patterns (i.e., no participant had the same missing item). Missing values were replaced by the mean of available responses for that individual on the variable (ipsative item replacement; Graham et al., 2003). Data were then screened for univariate and multivariate outliers using the protocol described by Tabachnick and

Fidell (2007). This led to the removal of two participants (n = 167). This procedure was repeated for samples two and three. For sample two, after two participants were removed for having missing data that exceeded 5%, 32 participants had missing data for one or two items (13 unique patterns). After ipsative item replacement, eight participants were removed as univariate and multivariate outliers (n = 212). Finally, for sample three, there were 14 cases with incomplete data (13 unique patterns). After ipsative item replacement, 11 participants were removed as univariate and multivariate outliers (n = 227).

Primary Analyses

Descriptive statistics and bivariate correlations are displayed in Table 1. Moderation analyses are reported in Table 2. Interactions are plotted in Figure 1.

Sport devaluation. The interaction model for sport devaluation was statistically significant; F (3, 163) = 10.78, p < .001. The two dimensions of perfectionism and their interaction term explained 16.55% of variance in sport devaluation (ΔR^2 interaction term = .02). PSP was not a significant predictor (B = 0.65 [95% CI = -0.40 to 1.70], t = 1.21, p =.227) and ECP was a significant positive predictor (B = 2.24 [95% CI = 0.46 to 4.03], t = 2.48, p =.014). The interaction term was statistically significant (B = -0.36 [95% CI = -0.70 to -0.02], t = -2.11, p = .036).

The J-N technique indicated that the conditional effect of PSP on sport devaluation was statistically significant (p < .05) at the point at individuals reported ECP ≥ 2.54 on a 1-to-7 response scale (10.66 on original scale). The change to a statistically significant conditional effect corresponded to PSP being related to lower levels of devaluation. In terms of coverage across the scores, 19.16 % of scores were below this point and 80.84% of scores were above.

Dedication. The interaction model for dedication was statistically significant; F (3, 208) = 23.51, $p < .001$. The two dimensions of perfectionism and their interaction term explained 25.32% of variance in dedication (ΔR^2 interaction term = .03). PSP was not a significant predictor (B = -0.08 [95% CI = -0.40 to 0.24], t = -0.49, p = .622) and ECP was a significant negative predictor (B = -0.77 [95% CI = -1.25 to -0.30], t =-3.22, p = .002). The interaction was statistically significant (B = 0.13 [95% CI = 0.04 to 0.22], t = 2.78, p = .006).

The J-N technique indicated that the conditional effect of PSP on dedication was statistically significant ($p < .05$) at the point at individuals reported ECP ≥ 1.87. The change to a statistically significant conditional effect corresponded to PSP being related to higher levels of dedication. In terms of coverage across the scores, 7.08% of scores were below this point and 92.92% of scores were above.

Enthusiasm. The interaction model for devaluation was statistically significant; F (3, 208) = 5.67, $p < .001$. The two dimensions of perfectionism and their interaction term explained 7.57% of variance in dedication (ΔR^2 interaction term = .02). PSP was not a significant predictor (B = -0.21 [95% CI = -0.57 to 0.15], t = -1.14, p = .255) and ECP was a significant negative predictor (B = -0.66 [95% CI = -1.20 to -0.11], t =-2.38, p = .018). The interaction term was statistically significant (B = 0.12 [95% CI = 0.01 to 0.22], t = 2.18, p = .030).

The J-N technique indicated that the conditional effect of PSP on enthusiasm was statistically significant ($p < .05$) at the point at individuals reported ECP ≥ 2.81. The change to a statistically significant conditional effect corresponded to PSP being related to higher levels of enthusiasm. In terms of coverage across the scores, 34.91% of scores were below this point and 65.01% of scores were above.

Expressive suppression. The interaction model for expressive suppression was statistically significant; F (3, 223) = 11.66, $p < .001$. The two dimensions of perfectionism and their interaction term explained 13.56% of variance in expressive suppression (ΔR^2 interaction term = .02). PSP was not significant predictor (B = -0.40 [95% CI = -1.03 to 0.22], t = -1.27, p = .206) and neither was ECP (B = -0.51 [95% CI = -1.40 to -0.37], t = -1.24, p = .255). The interaction term was statistically significant (B = 0.20 [95% CI = 0.003 to 0.41], t = 2.00, p = .047).

The J-N technique indicated that the conditional effect of PSP on expressive suppression was statistically significant ($p < .05$) at the point at individuals reported ECP $\geq$ 2.83 on 7-point response scale (9.48 on the original scale). The change to a statistically significant conditional effect corresponded to PSP being related to higher levels of suppression. In terms of coverage across the scores, 46.26% of scores were below this point and 53.74% of scores were above.

Simple slopes analysis and J-N technique. To illustrate what information is gained from the two techniques, and how it is complementary, a comparison of the findings using simple slopes analysis and J-N technique is provided in Table 3. This comparison illustrates how the level at which the conditional effect becomes statistically significant occurs outside of the levels assessed as part of testing the 2 × 2 model. Specifically, in two of four instances (devaluation, enthusiasm, and suppression), the conditional effect became statistically significant after the first point at which the conditional effect is typically tested in simple slopes analysis (low levels of ECP / 1 SD below the mean of ECP) but before the second point it is typically tested in simple slopes analysis (high levels of ECP / 1 SD above the mean of ECP). These correspond to 0.79, 0.49, and 0.17 standard deviations below the mean, respectively. In the other instance (dedication), the level at which the conditional effect becomes statistically significant

occurs before the first point the conditional effect is typically tested in simple slopes analysis (low levels of ECP / 1 SD below the mean of ECP). This corresponds with 1.46 standard deviations below the mean.

Discussion

The aim of the current study was to illustrate the use of the J-N technique in probing significant interactions between dimensions of perfectionism and identifying perfectionistic tipping points. Secondary analysis of existing data that had previously provided evidence of interactions between PSP and ECP when predicting dimensions of athlete burnout, athlete engagement, and coach emotion regulation was used. Perfectionistic tipping points were identified for each outcome and findings were compared with simple slopes analyses to demonstrate the additional and complementary information provided by the J-N technique.

J-N Technique and Perfectionistic Tipping Points

The central premise of the current study is that there is more to be learned from research that has examined the interaction between dimensions of perfectionism. In addition, to fully understand the interplay between dimension of perfectionism and, in turn, draw more valid conclusions regarding the effects of perfectionism in sport and exercise, additional analytical approaches are required. In the current study it was illustrated how the J-N technique can be used to supplement the way statistically significant interactions are typically probed to identify the specific levels of ECP that correspond with the conditional effects of PSP are statistically significant (perfectionistic tipping points). Because this technique examines conditional effects across all levels of ECP, as opposed to at a smaller number of points, no statistically significant conditional effects are missed. The result is a fuller account of the interaction effect and

advances in our understanding of for whom perfectionism is likely to be problematic, beneficial or neutral.

Three types of perfectionistic tipping points were illustrated in the current study. The first signaled that, at a specific level of ECP, PSP had a discernibly stronger positive relationship with a desirable outcome variable. This was the case for both dedication and enthusiasm. Specifically, at (much) lower levels of ECP, PSP was not significantly related to the two outcomes. However, at (slightly) higher levels of ECP, PSP was significantly and positively related to the two outcomes. As such, in these two instances, the J-N technique revealed there was a point at which the effect of PSP "tipped" to being more identifiably positive. In regard to what this tells us about the interplay between PSP and ECP, it suggests that ECP includes a motivational component that strengthens a commitment to sport. This is consistent with the notion that while ECP may not be energizing in the same manner as PSP, it does correspond with a strong psychological commitment to the importance of perfection (Dunkley et al., 2006).

A second tipping point was evident for a different scenario. At a specific level of ECP, PSP had a discernibly stronger negative relationship with an undesirable outcome variable. This was the case for sports devaluation. Specifically, at lower levels of ECP, PSP was not significantly related to sport devaluation. However, at (slightly) higher levels of ECP, PSP became significantly and negatively related to sport devaluation. Much like the observed effects on dedication and enthusiasm, this tipping point once again was consistent with how, from a motivational perspective, levels of ECP may intensify the importance attached to sport participation. In regard to the 2 × 2 model, this effect can be understood in terms of the consequences of the interplay between external motives associated with ECP (e.g., using sport to attain the approval of others) and the internal motives related to PSP (e.g., using sport to attain

self-approval). That is, as ECP increases, there may be a quantitative increase in total amount of motivation (more intense commitment to goals) as well as a shift in quality of motivation (internal regulation to both internal and external regulation) athletes exhibit.

In contrast to the first two tipping points, the third perfectionistic tipping point signaled a point at which PSP becomes problematic. Specifically, at a specific level of ECP, PSP had a discernibly stronger positive relationship with an undesirable outcome. This was evident in regards to expressive suppression. So, alongside increasing athlete commitment and the value attached to sport, lower levels of ECP were also found to have an adverse influence on emotion regulation. In this case, it triggers greater inhibition of emotion-expressive behavior and the need for more effortful management of emotions. Research suggests that emotion regulation of this kind contributes to lower general well-being and poorer interpersonal functioning (Gross 1998; Gross & John 2003; Richards & Gross 2000). A more complex picture, then, begins to emerge with this perfectionistic tipping point serving as a reminder of the adverse influence of ECP, especially once the effects studied are in regards to wellbeing related outcomes (see Hill et al., 2018).

One other perfectionistic tipping point worth considering includes a similar scenario – a specific level of ECP at which PSP has a discernibly stronger negative relationship with a desirable outcome variable. In other words, as with the previous tipping point, PSP becomes more problematic as ECP increases. This tipping point was not illustrated in the current study and, as yet, has not emerged in research examining interactive effects of perfectionism in sport. However, it is likely that this tipping point will be evident for certain outcomes. One candidate that is worthy of examination in this regard is self-acceptance (see Hill et al., 2008). Self-acceptance is an important variable to perfectionism with some researchers suggesting that a lack

of self-acceptance is a core feature of perfectionism and key to its consequences (e.g., Greenspon, 2000, 2008). If a level of ECP at which PSP has a significant and negative relationship with self-acceptance can be identified, it would be an especially important demarcation of which athletes are vulnerable to perfectionistic problems.

Given the effects evident in the first two perfectionistic tipping points, a note of caution is perhaps required. There may be a temptation to consider the two tipping points as evidence that higher levels of ECP can be advantageous for athletes. At this point, this would be a premature for a number of reasons. First, the relationships include no consideration of situational factors, essentially providing a gauge of "for whom" perfectionism is problematic and beneficial but not "when" this is the case. Initial research examining the interaction between ECP and PSP has already provided evidence that effects vary depending on both the situation (e.g., varying goal progress and competitive failure) and outcomes measured (e.g., performance versus emotions; Crocker et al., 2014; Curran & Hill, 2018; Lizmore et al., 2019). Second, as also evidenced in the current study, other perfectionistic tipping points exist and operate in an opposing way, some making PSP more problematic. As such, instead, identification of the first two tipping points is best considered evidence that the interaction between PSP and ECP is complex and has substantive implications for considering the likely effects of perfectionism.

One interesting final issue to consider is the actual levels of ECP associated with a perfectionistic tipping point. For all outcomes in the current study, the tipping point occurred below the mean level of ECP in the sample and below the mid-point of the response-scale. In other words, not a great deal of ECP was required in order to alter how PSP relates to various outcomes in sport. This finding alludes to the potency of ECP and the importance of studying the interplay between ECP and PSP. Also, the non-arbitrary nature of the levels of ECP may have

practical utility. For example, such perfectionistic tipping points may signal when perfectionism is most problematic for athletes and allow for more focused interventions. However, it is important to note that perfectionistic tipping points will depend on, among other factors, context, sample characteristics and the outcome measured. Researchers should also be particularly mindful of how differences in the way PSP and ECP are operationalized will influence perfectionistic tipping points and make comparisons across studies difficult.

Limitations and other future directions

In probing interactions with the J-N technique, and generally, researchers will need to be mindful of a number of possible limitations. Some of those that apply to the current study are listed here.

First, reliability of the measures is important. The lower the reliability of the predictor and moderator, the lower the reliability of the interaction term and statistical power (Frazier et al., 2004). This issue is pertinent to sample two where one of the predictors displayed lower reliability.

Second, sample size is important when testing and probing interactions. Studies need to ensure that there is sufficient power to detect interactions and, in addition, be mindful of how sample sizes effect perfectionistic tipping points. The statistical significance of a conditional effect of a given size will vary depending on sample size. As such, in some cases, a focus on the size of the conditional effect will also be beneficial in identifying whether it is both meaningful and statistically significant.

Third, it is important to stress that perfectionistic tipping points do not in any way convey diagnostic information and are not suitable for that purpose. Rather they represent points of

conceptual and statistical interest that help advance our understanding of the way dimensions of perfectionism interact.

Fourth, the illustration of the J-N technique here applied to linear effects and cross-sectional data. However, it is a flexible approach that can be applied to non-linear effects and longitudinal data (e.g., Miller et al., 2013). The latter being required to move closer to understanding the causal effects of the interactions observed (e.g., Madigan et al., 2016).

Finally, there are different ways to perform the J-N technique. Here, the PROCESS macro for SPSS was used (version 3.4; Hayes, 2013). This is simple and user friendly so should be appealing to researchers. However, the J-N technique is available for in other software (e.g., MPlus and R; see Lin, 2020). Some of which have other desirable features such as different graphing functions and ways of dealing with missing data, the latter being particularly important when dealing with longitudinal data.

Conclusion

The J-N technique offers a way of probing interactions that tests the statistical significance of conditional effects across the full range of scores. In doing so, the technique allows for the identification of perfectionistic tipping points at which the effects of PSP are altered by ECP. Three different types of perfectionistic tipping points were identified in the current study that indicated PSP can become more and less problematic even at lower levels of ECP. It is recommended that researchers use the J-N technique to identify perfectionistic tipping points to supplement other approaches, such as in the 2 x 2 model of perfectionism, or when examining interactions among perfectionism dimensions, generally.

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Table 1 – Descriptive statistics, bivariate correlation coefficients and Cronbach's alpha

	M	*SD*	α	1	2	3
Sample 1						
1. PSP	5.21	0.48	.71			
2. ECP	3.05	0.65	.89	.27**		
3. Devaluation	1.74	0.70	.78	-.22**	.23**	
Sample 2						
1. PSP	5.15	0.84	.56			
2. ECP	3.29	0.98	.66	.21**		
3. Dedication	4.24	0.61	.80	.44**	-.08	
4. Enthusiasm	4.25	0.63	.80	.21**	-.05	.69**
Sample 3						
1. PSP	4.23	0.91	.87			
2. ECP	2.95	0.76	.86	.48**		
3. Expressive suppression	3.98	1.14	.70	.28**	.32**	

Notes. *p <. 05; **p <. 01; Mean and SD values for PSP and ECP in samples 1 and 2 are converted to 1-to-7 response scale.

Table 2 – Interaction models

	Indicator of PSP		Indicator of ECP		Interaction term	
	B	*SE*	*B*	*SE*	*B*	*SE*
Sample 1: Burnout						
Devaluation	0.65	0.53	2.24*	0.90	-0.36*	0.17
Sample 2: Engagement						
Dedication	-0.08**	0.16	-0.77**	0.24	0.13*	0.05
Enthusiasm	-0.21**	0.18	-0.66*	0.28	0.12*	0.05
Sample 3: Regulation						
Expressive suppression	-0.40	0.32	-0.51	0.56	0.20*	0.10

Notes. *$p < .05$; **$p <. 01$. PSP = Personal standards perfectionism. ECP = Evaluative concerns perfectionism. *B* = unstandardized regression coefficients. *SE* = standard error.

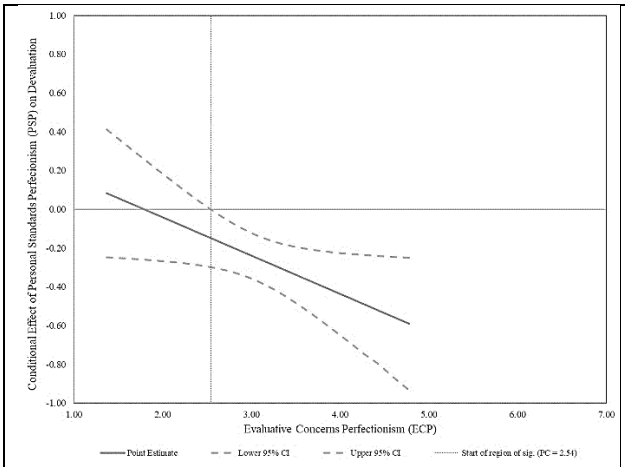
Table 3 – Comparison of information gained from simple slopes analysis and J-N technique

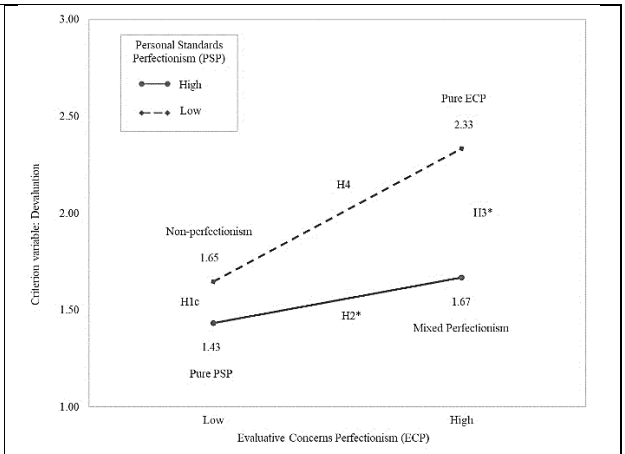
		Conditional effects	
	ECP	*B*	*SE*
Sample 1: Burnout			
Simple slopes			
PSP on Devaluation at low ECP	2.40	-.22	.15
PSP on Devaluation at high ECP	3.71	-.70**	.16
J-N technique			
PSP on Devaluation at ECP perfectionistic tipping point	2.54†	-.27	.14
Sample 2: Engagement			
Simple slopes			
PSP on Dedication at low ECP	2.31	.22**	.07
PSP on Dedication at high ECP	4.27	.47**	.06
J-N technique			
PSP on Dedication at ECP perfectionistic tipping point	1.87†	.16	.08
Simple slopes			
PSP on Enthusiasm at low ECP	2.31	.06	.07
PSP on Enthusiasm at high ECP	4.27	.28**	.07
J-N technique			
PSP on Enthusiasm at ECP perfectionistic tipping point	2.81†	.12*	.06
Sample 3: Regulation			
Simple slopes			
PSP on Suppression at low ECP	2.20	.05	.12
PSP on Suppression at high ECP	3.71	.36**	.12
J-N technique			

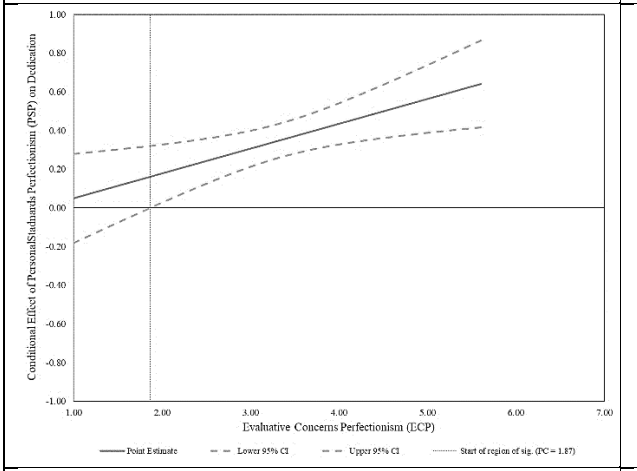
PSP on Suppression at ECP perfectionistic tipping point	2.83†	.18	.09

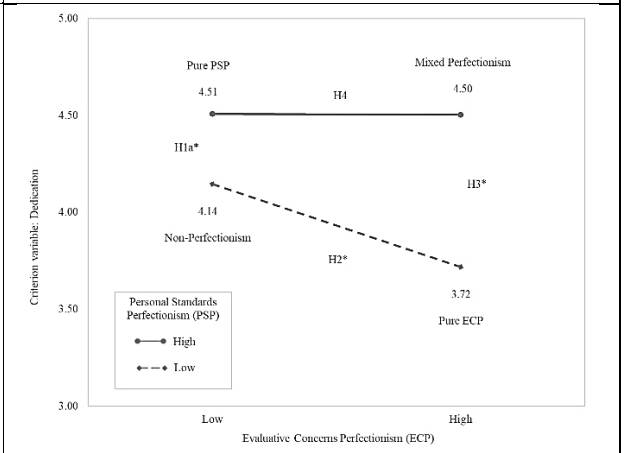
Notes. *p < .05; **p <. 01. PSP = Personal standards perfectionism. ECP = Evaluative concerns perfectionism. † = Conditional effect is significant if ECP is above this level.

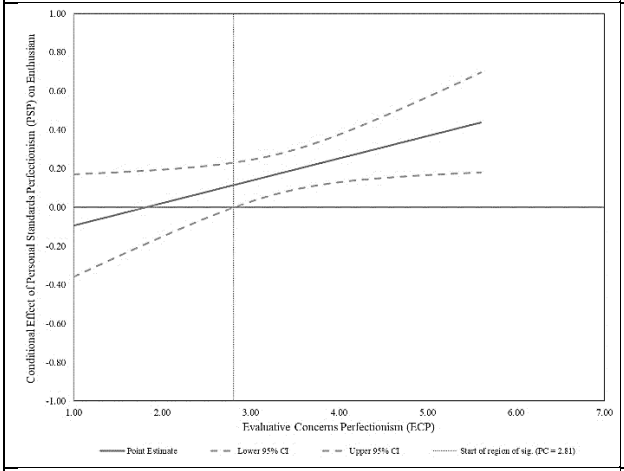
RE-PROBING INTERACTIONS

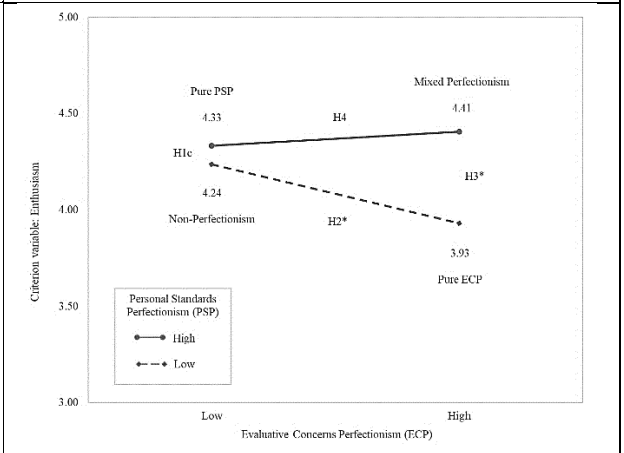


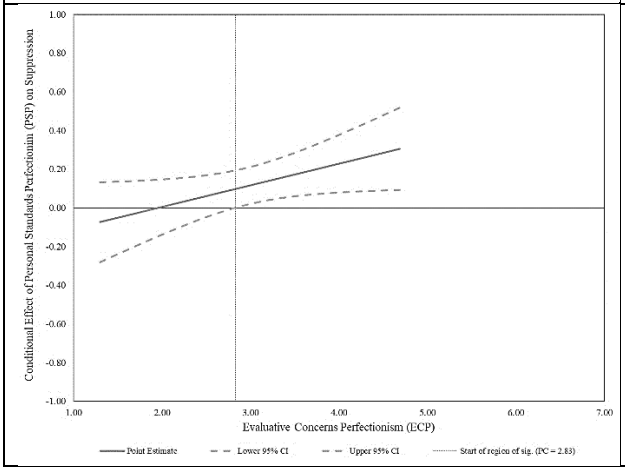












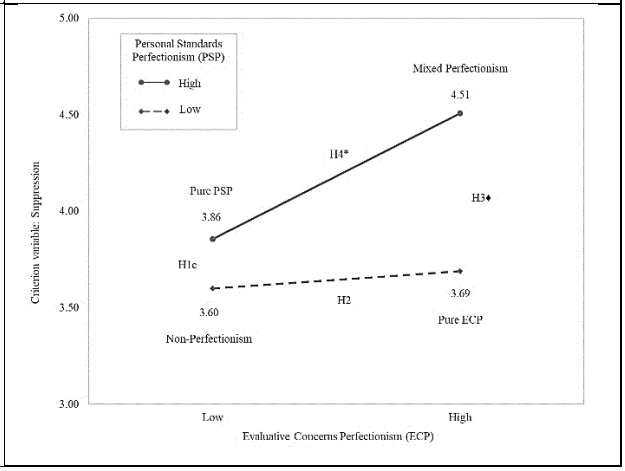


Figure 1. Conditional effects of PSP on criterion variables as ECP increases (J-N technique) and corresponding simple slopes analysis testing hypotheses of the 2 × 2 model of perfectionism. Note: H = Hypothesis, * = statistical support for the hypothesis (p <.05), ♦ = statistical support for the hypothesis in the opposite direction.