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Combined Effects, Total Unique Effects and Relative Weights of Perfectionism

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Abstract

It has recently been argued that because the major two dimensions of perfectionism (perfectionistic strivings and perfectionistic concerns, PS and PC) can have opposing effects, the “combined effect” should be calculated to understand whether, overall, perfectionism is neutral, adaptive, or maladaptive. In this methodological note we revisit the task of disentangling the overall effects of PS and PC. In doing so, we illustrate a new and alternative approach – calculation of the total unique effect and the relative weights of PS and PC. The total unique effect is the simplest way of ascertaining whether perfectionism is neutral, adaptive, or maladaptive. However, like the combined effect, it does not convey information regarding the relative importance of PS and PC. Calculating the relative weights of PS and PC does so and provides a fuller account of the overall effect of perfectionism and the precise role of each dimension when predicting a given outcome. We close the paper by applying this approach to a range of outcomes reported in recent meta-analyses in this area. In doing so, perfectionism is revealed to be primarily maladaptive and rarely adaptive or neutral, with the relative contribution of perfectionistic concerns being the main reason why this is the case.

Combined Effects, Total Unique Effects and Relative Weights of Perfectionism

Perfectionism is multidimensional – at its broadest level including two-higher-order dimensions of perfectionistic strivings (PS) and perfectionistic concerns (PC). PS capture unrealistically or exceedingly high personal standards and striving for perfection and PC capture concern over mistakes, fear of imperfection, feelings of discrepancy from personal standards, and negative reactions to imperfection (Stoeber, Madigan, & Gonidis, 2020). The two dimensions are typically positively correlated and, sometimes, highly positively correlated with effects medium-to-large in size most common. However, they can also have opposing effects. That is, PS and PC can be related to the same outcomes in the same way (e.g., depression, eating disorders, and workaholism; Harari et al., 2018; Limburg et al., 2017) but can also be related to other outcomes in the opposite way (e.g., academic achievement, burnout, procrastination; Hill & Curran, 2016; Madigan, 2019; Sirois, Molnar, & Hirsch, 2017).

When the two dimensions have opposing effects, is perfectionism adaptive, maladaptive, or neutral? To answer this question, Stoeber et al. (2020) recently argued that the "combined effect" (CE) of perfectionism should be calculated. Couched within the 2 × 2 model of perfectionism (Gaudreau & Thompson, 2010), Stoeber and colleagues (2020) defined the CE as the difference between a mixed subtype of perfectionism (high PS + high PC) and a non-perfectionism subtype of perfectionism (low PS + low PC); $CE = 2(\beta_{PS} + \beta_{PC})$. Thereafter, they illustrated different ways the CE can be calculated and how it varies as a function of the relationships of PS [r(PS,Y)] and PC [r(PC,Y)] with the outcome variable (Y) and the relationship between PS and PC [r(PC, PS)]. Finally, they provided useful examples of neutral, adaptive, and maladaptive combined effects from published research.

Stoeber et al. (2020) have provided a novel and innovative way to study perfectionism as a multidimensional characteristic and ascertain its overall effects without having to adopt a unidimensional approach (i.e., using a total perfectionism score). The CE is particularly useful to those who wish to compare subtypes of perfectionism in the 2 × 2 model, essentially adding a new a priori comparison and hypothesis to the model (Hypothesis 5: mixed perfectionism will be associated with worse outcomes than non-perfectionism). The CE is also useful for those who wish to test the comparative benefits of perfectionism in a standalone manner outside of the 2 × 2 model and simply want to know whether it is typically better or worse to be more perfectionistic. In these regards, the CE is a welcome addition to perfectionism research.

These strengths aside, the CE is only one way to answer the question of whether, perfectionism is, overall, neutral, adaptive, or maladaptive. It will not always be the most appropriate way to answer this question which will depend on the precise research question. Notably, too, it relies on a “pick-a-point” approach to creating the two combinations of perfectionism that may not be desirable or optimal when studying perfectionism (see Hill, 2021). With this in mind, here, we illustrate an alternative method – calculating the total unique effect (TUE) of PS and PC and their relative weights. In regards to calculating relative weights, we make no claim of originality. Rather, we refer readers to the excellent work of Johnson (2000) and Tonidandel and LeBreton (2011), among others, who helped derive the method and have illustrated its use in other contexts. Here, we aim to demonstrate the value of applying the method to understanding the effects of perfectionism alongside calculating the TUE.

TUE of Perfectionism

In addition to calculating the CE, those interested in whether perfectionism is, overall, neutral, adaptive, or maladaptive can also calculate the TUE; TUE = $\beta_{PS} + \beta_{PC}$. Note that although Stoeber et al. (2020, p. 2) also defined the combined effect as “PS + PC”, when expressed in this way it is more accurately identified as the TUE, rather than the CE. The

TUE is statistically and conceptually distinct from the CE. This is evident in the way the two are calculated; $\beta_{PS} + \beta_{PC}$ versus $2(\beta_{PS} + \beta_{PC})$. It is also evident in that the CE is a standardised mean difference (Cohen's *d*) that reflects a comparison of two different combinations of perfectionism (high PS + high PC versus low PS + low PC) whereas the TUE is a standardised change score that reflects the total change in the outcome variable following a one standardised unit increase in *both* PS and PC.

The TUE provides a simple and straightforward means of ascertaining whether the overall effect of perfectionism is neutral, adaptive, or maladaptive. When the positive effect of PS is larger than the negative effect of PC ($\beta_{PS} > \beta_{PC}$), the TUE will reveal perfectionism to be adaptive. Likewise, when the positive effect of PS is smaller than the negative effect of PC ($\beta_{PS} < \beta_{PC}$), the TUE will reveal perfectionism to be maladaptive. By way of example, when examining the relationship between perfectionism and life satisfaction, Suh, Gnika, and Rice (2017) found that $\beta_{PS} = .22$ and $\beta_{PC} = -.39$, therefore, TUE = -.17 (.22 + -.39). In this case, while PS is related to higher life satisfaction and PC is related to lower life satisfaction, overall, perfectionism is related to lower life satisfaction. Therefore, perfectionism would be considered maladaptive in regard to life satisfaction.

One additional piece of information we would be interested in is whether TUE is statistically significant. This can be ascertained by calculating the standard error (SE) of the TUE. The TUE is then divided by the SE and the result looked up in a normal probability table to identify the probability that the TUE is different from zero (TUE $\neq$ 0). Note that the critical value that must be exceeded to denote statistically significance depends on degrees of freedom (n – number of variables – 1). Confidence intervals (e.g., 95%) can also be created for the TUE; TUE - 1.96(SE) $\leq$ TUE $\leq$ TUE + 1.96 (SE). Revisiting the life satisfaction example, we find that the TUE of perfectionism on life satisfaction is statistically significant and produces 95% Confidence internals of -.32 to -.03.

Here we provide a worked example of the full method to derive the TUE, its standard error, and confidence intervals is provided. The information required is the bivariate correlations between PS, PC, and the outcome variable, along with the sample size. The method uses equations provided by Cohen and Cohen (2003) to calculate standardised betas for PS and PC (EQ 3.2.4, p.68) and multiple R (EQ 3.3.1, p.70). We provide an equation for the standard error of TUE. The information required for this equation comes from the inverse correlation matrix (illustrated by Cohen & Cohen, 2003, p.636-638). Using this method and information routinely provided in most studies allows the TUE and its statistical significance to be calculated for any study and outcome variable. The data used in the example below comes from Burcas and Cretu (2020) meta-analysis of perfectionism and test anxiety (reported in Table 1).

The method includes three steps. In step 1 we calculate standardised beta values (β) from the bivariate correlation coefficients between PS, PC, and the outcome variable:

$$\beta_{YPS.PC} = \frac{r_{YPS} - r_{YPC}\, r_{PSPC}}{1 - r_{PSPC}^2}$$

$$\beta_{YPC.PS} = \frac{r_{YPC} - r_{YPS}\, r_{PSPC}}{1 - r_{PSPC}^2}$$

$r_{YPS} = 0.04$

$r_{YPC} = 0.42$

$r_{PSPC} = 0.32$

$n = 4521$

$k = 2$

$\beta_{YPS.PC} = -0.11$

$\beta_{YPC.PS} = 0.45$

In step 2, we calculate multiple R and multiple R^2:

$$R^2_{Y.PSPC} = \frac{r^2_{YPS} + r^2_{YPC} - 2r_{YPS}r_{YPC}r_{PSPC}}{1 - r^2_{PSPC}}$$

$$R_{Y.PSPC} = \sqrt{\frac{r^2_{YPS}+r^2_{YPC} - 2r_{YPS}r_{YPC}r_{PSPC}}{1 - r^2_{PSPC}}}$$

$R^2_{Y.PSPC} = 0.19$

$R_{Y.PSPC} = 0.44$

In step 3 and final step, we calculate the standard error of TUE, TUE and 95% confidence intervals using the information from step 1 and step 2:

Correlation matrix

$$r = \begin{pmatrix} 1 & r_{PSPC} \\ r_{PCPS} & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0.32 \\ 0.32 & 1 \end{pmatrix}$$

Inverse correlation matrix

$$r^{-1} = \begin{pmatrix} \frac{1}{1 - r^2_{PSPC}} & \frac{r_{PSPC}}{1 - r^2_{PSPC}} \\ \frac{r_{PCPS}}{1 - r^2_{PSPC}} & \frac{1}{1 - r^2_{PSPC}} \end{pmatrix} = \begin{pmatrix} 1.11 & -0.36 \\ -0.36 & 1.11 \end{pmatrix}$$

Standard error of *TUE* (SE_{TUE})

$$SE_{TUE} = \sqrt{\frac{1 - R^2_{Y.PSPC}}{n - k - 1}(r^{-1}_{11} + r^{-1}_{22} + r^{-1}_{12})}$$

$r^{-1}_{\mathbf{11}} = r^{-1}_{22} = 1.11$

$r^{-1}_{12} = -0.36$

$SE_{TUE} = 0.02$

TUE

$$TUE = \beta_{YPS.PC} + \beta_{YPC.PS}$$

$$TUE = 0.34$$

95% confidence internals (two-tailed, critical value +/-1.96)

$$TUE - (1.96 \times SE_{TUE}) \leq TUE \leq TUE + (1.96 \times SE_{TUE})$$

$$0.30 \leq TUE \leq 0.38$$

In using these steps and the data from Burcas and Cretu 2020) we have determined that the TUE of perfectionism on test anxiety in 0.34 [.30, .38] and that this effect is statistically significant (the confidence intervals do not include zero).

Relative weights of perfectionism

As useful as the TUE is, one of its limitations is that it does not always account for the variance shared between PS and PC. It accounts only for the unique variance between PS and the outcome variable and PC and the outcome variable. When the two predictors are orthogonal (i.e., uncorrelated) this is not problematic as there is no shared variance to account for. However, when predictors are correlated, as is very often the case for perfectionism, it is problematic as it becomes unclear which variable is making the largest contribution to the outcome variable. In addition, as noted by Johnson (2000), when predictors are correlated, it is more likely for standardised regression coefficients to be (1) inflated for predictors that are more highly correlated with the dependent variable at bivariate level, (2) deflated for predictors that are less correlated with the dependent variable at bivariate level, and (3) reversed so that positive bivariate correlations become negative standardised regression coefficients, or vice versa (viz. suppression).

This latter issue, suppression, is commonly observed in perfectionism research (see Stoeber & Otto, 2006). In multiple regression, suppressor variables increase the magnitude of regression coefficients associated with other independent variables (Conger, 1974). In the context of multidimensional perfectionism, this happens because the two dimensions act to suppress criterion-irrelevant variance in each other (mutual, reciprocal or cooperative suppression; Paulhus, Robins, Trzesniewski, & Tracy, 2004). Suppression can be detected by comparing the bivariate correlation coefficient between the predictor and the criterion variable with the corresponding regression coefficient. Suppression is evident when the regression coefficient is larger than the bivariate correlation coefficient or is in the opposite direction (Cohen, Cohen, Aiken & West, 2003). When the latter is the case it can create interpretational difficulties at a conceptual level if seeking to draw conclusions regarding the effects of the original predictor variable (Lynam et al., 2006).

One way of avoiding these issues is to calculate relative importance indices. As described by Tonidandel and LeBreton (2011), relative importance indices estimate the contribution a variable makes by itself and in combination with other variables to an outcome variable. Here we focus on one relative importance index – the relative weight of each predictor (Johnson, 2000). That is, the proportionate contribution each predictor makes to the total squared multiple correlation for the model (Johnson, 2000). In the context of perfectionism, critically, the relative weights of PS and PC indicate which one matters more in predicting outcome variables. Unlike squared standardised regression coefficients, relative weights sum to the model R^2 and account for all variance. They can therefore be interpreted as the percentage of variance explained in the criterion that can be attributed to each predictor and as a relative effect size (LeBreton et al. 2007).

Relative weights are calculated by transforming the original variables into new variables that are orthogonal. In this way, no issues arise associated with partitioning shared variance as there is no shared variance. The standardized regression coefficients for the new transformed variables are used for the purpose of calculating relative weights before then transforming them back to the metric of the original variables. Tonidandel and LeBreton (2011) illustrate how this is done via a series of four steps; (1) derive a set of orthogonal weights maximally related to the original predictors, (2) obtain a set of standardised regression coefficients by regressing Y on the orthogonal predictors, (3) obtain a set of standardised regression coefficients by regressing the set of original predictors on the set of orthogonal predictors, and (4) calculate relative weights by summing the products of squared standardised coefficients from steps 2 and 3 for each variable. These steps can be completed easily using an R-based Web Tool: https://relativeimportance.davidson.edu/ (Tonidandel & LeBreton, 2014).

Total Recall: An Illustration of the TUE using Previous Research

To illustrate the usefulness of what we are proposing, we have provided the combined effects, TUEs, standardised regression coefficients, and relative weights of PS and PC for a number of recent published meta-analyses (Table 1). We included studies when all information required to calculate these effects were available in the published article (notably, the correlations between PS, PC, Y). These include studies that have examined academic achievement (Madigan, 2019), burnout (Hill & Curran, 2016), various psychopathologies (Limberg et al., 2017), procrastination (Sirois, Molnar, & Hirsch, 2017), test anxiety (Burcaş & Creţu, 2020), work engagement (Harari et al., 2018), and workaholism (Harari et al., 2018). These studies are illustrative, rather than exhaustive.

The effects displayed show a number of the aforementioned qualities of these statistics;

First, it is evident that TUE is different from the CE with the two effects conveying different information. The TUE conveys standardised change as PS and PC increase whereas the CE conveys a standardised difference between subtypes of perfectionism (mixed perfectionism versus non-perfectionism).

Second, the problems with partitioning variance and signalling of importance in regression are evident across studies, most clearly in regards to evidence of suppression. Specifically, suppression is evident in the comparison between the bivariate correlations and standardised regression coefficients in 14 of 24 instances with all but one indicating mutual suppression.

Third, in most cases the use of standardised regression coefficients would be misleading in regards to ascertaining the relative importance of PS and PC. As examples, based on squared regression coefficients, the contribution of PC is nearly three times larger than PS when predicting burnout, 16 times larger when predicting depression and just over three times larger when predicting bulimia nervosa. In actuality, the relative weights reveal that the contribution of PC is four times larger for burnout, nine times larger for depression, and nearly two times larger for Bulimia. As such, relative weights are required to more accurately ascertain the contribution of PS and PC and are a useful addition to calculating the TUE.

Is Perfectionism Neutral, Adaptive, or Maladaptive?

There is no easy answer to this question. Perfectionism is complex and its effects will be determined by an array of factors. However, the TUE (and CE) can help ascertain whether, typically, research has found perfectionism to be, overall, neutral, adaptive, or maladaptive. Based on recent meta-analytical studies, calculation of TUEs indicated that perfectionism was adaptive for academic achievement and was neutral for procrastination. However, all other effects revealed perfectionism to be maladaptive, with the largest TUEs evident for anorexia nervosa, bulimia nervosa, and workaholism. As such, focusing on TUE indicates that perfectionism is primarily maladaptive. In addition, based on relative weights, PC is principally responsible for these effects. In other words, PC is the major contributing factor to the maladaptive effects of perfectionism observed in research so far.

Limitations and other approaches

In calculating the TUE of perfectionism researchers should be mindful of a number of limitations. First, TUE is based on regression analysis that has a number of statistical requirements (e.g., homoscedasticity, adequate sample size). Bias and precision of estimates of the TUE will be affected if these requirements are not met in the same way that other estimates would be in regression. Second, similarly, reliability of measurement is equally important to TUE as other techniques (e.g., attenuating correlations, reducing statistical power). One way to improve estimates of TUE in this regard is to use a latent variable (error-free) correlation matrix rather than the bivariate correlation matrix as the starting point. Third, other analyses are available to researchers to partition variance in multiple regression and aid interpretation of unique, common, and total effects (e.g., commonality analysis; see Kraha et al., 2012). These analyses should be considered alongside the approach we propose here (TUE and relative weights). Readers may find that in some cases alternative approaches will better suit their aims. In addition, these other analyses may offer further insight into the overall effect of perfectionism.

Closing Remarks

By introducing the TUE of perfectionism, we have illustrated a new way to determine whether perfectionism is neutral, adaptive, or maladaptive. In addition, by combining the TUE with relative weights analyses, we have provided a means to determine which of the two higher order dimensions of perfectionism contributes most in explaining variance in any given outcome. Research seeking to gain a fuller understanding of the consequences of perfectionism would benefit from adopting this approach. Such work has the potential to significantly progress our understanding of perfectionism as a multidimensional construct that includes two related, but sometimes opposing, dimensions of perfectionism. The use of this approach when examining recent meta-analytical research here shows that, overall, perfectionism is typically maladaptive and rarely adaptive or neutral.

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Table 1.

Bivariate correlations, standardised regression coefficients, total unique effects, combined effects, and relative weights from meta-analyses

Study	DV	*k*	*N*	$r_{(PS\ Y)}$	$r_{(PC\ Y)}$	$r_{(PS\ PC)}$	β_{PS}	β_{PC}	TUE [95% CI]	CE	β^2_{PS}	β^2_{PC}	RW_{PS} (%)	RW_{PC} (%)	R^2_{MODEL}
Burcaş & Creţu (2020)	Test anxiety	22	4521	.04	.42	.32	-.11	.45	.35 [.32, .38]	.70	.01	.20	.01 (3.09)	.18 (96.91)	.19
Harari et al. (2018)	Workaholism	15	3728	.14	.47	.29	.00	.47	.47 [.44, .51]	.94	.00	.22	.01 (4.44)	.21 (95.56)	.22
Harari et al. (2018)	Work engagement	9	1376	.29	-.16	.29	.37	-.27	.10 [.04, .16]	.20	.14	.07	.10 (69.61)	.05 (30.39)	.15
Hill & Curran (2016)	Burnout	34	8244	-.14	.41	.32	-.30	.51	.20 [.18, .23]	.40	.09	.26	.05 (20.30)	.20 (79.70)	.25
Limberg et al. (2017)	Depression	12	2412	.18	.40	.44	.00	.40	.40 [.36, .45]	.82	.00	.17	.02 (10.14)	.14 (89.86)	.16
Limberg et al. (2017)	Bulimia nervosa	9	1809	.36	.45	.44	.20	.36	.56 [.51, .61]	1.12	.04	.13	.08 (34.89)	.16 (65.41)	.24
Limberg et al. (2017)	Anxiety disorders	49	9849	.07	.30	.44	-.08	.33	.26 [.23, .28]	.52	.01	.11	.00 (5.10)	.09 (94.90)	.09
Limberg et al. (2017)	OCD	32	6432	.11	.35	.44	-.05	.37	.32 [.29, .35]	.64	.00	.14	.01 (5.80)	.12 (94.20)	.13
Limberg et al. (2017)	Anorexia nervosa	8	1608	.56	.81	.44	.25	.70	.95 [.92, .98]	1.90	.06	.49	.18 (25.80)	.53 (74.20)	.71
Limberg et al. (2017)	Suicidal ideation	22	4422	.09	.31	.44	-.06	.34	.28 [.24, .31]	.56	.00	.12	.01 (5.45)	.09 (94.55)	.10
Madigan (2019)	Achievement	48	8608	.24	-.08	.32	.30	-.17	.12 [.10, .15]	.24	.09	.03	.07 (80.12)	.02 (19.88)	.09
Sirois, Molnar, & Hirsch (2017)	Procrastination	43	10000	-.22	.23	.10	-.25	.25	.01 [-.02, .03]	.02	.06	.06	.05 (48.00)	.06 (52.00)	.11

Note: *k* = Number of effect sizes. *N* = Number of participants; *N* was not reported in Limberg et al (2017) so an estimate is used (total sample size divided by total number of studies [57200/284]*number of effects). DV = Dependent variable. β = Standardised regression coefficient. TUE = Total unique effect ($\beta_{PS} + \beta_{PC}$; units of standard deviations of DV per standard deviation of PS + PC). CE = Combined effect (Cohen's *d*). RW = Relative weight. PS = Perfectionistic strivings. PC = Perfectionistic concerns. Rounding to two decimal places accounts for any differences between $\beta_{PS} + \beta_{PC}$ and TUE. If 95% CI (confidence intervals) do not include zero, the TUE is statistically significant ($p < .05$).