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Autonomy support in sport and exercise settings: a systematic review and meta-analysis

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ABSTRACT

Drawing from self-determination theory (SDT) and a database of 1,320 correlations across 131 independent samples ($N = 38{,}844$), we conduct a systematic review and meta-analysis of coach autonomy support in sport and exercise settings. Results showed autonomy support was strongly positively associated with athlete well-being and negatively associated with distress. Consistent with SDT, meta-analyzed correlations were strongest for autonomous forms of athlete motivation ($\rho = .39$) and weaker for controlled forms of motivation (introjected regulation $\rho = .16$, external regulation $\rho = -.01$), and negative with amotivation ($\rho = -.19$). We found strong positive associations between autonomy support and athlete basic psychological needs for autonomy, competence, and relatedness and very strong associations between autonomy support and other climate or behavioral supports for athlete basic psychological needs: competence support; relatedness support; structure; involvement; and task-involving climates. Effects were not moderated by culture, with collectivist and individualist cultures generally yielding effects in the strong range ($\rho \geq .35$), providing support for the assumption within SDT of universal benefits of autonomy support. Effects were also not moderated across types of sport. We discuss implications of the review and suggest coach autonomy support is consistent with environments supporting autonomous motivation, basic psychological needs, and well-being.

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Coach autonomy support; sport; exercise; systematic review; meta-analysis; self-determination theory

Over the past two decades, researchers have used self-determination theory (SDT; Ryan & Deci, 2000, 2017) to establish the motivation-based foundations of wellness and positive functioning in sport and exercise settings. One line of inquiry has focused on interpersonal climates that nurture autonomy, potentially yielding increased enjoyment and intrinsic motivation for sport (Balaguer et al., 2012; Pulido, Sánchez-Oliva, Sánchez-Miguel, et al., 2018; Mageau & Vallerand, 2003). The popularity of autonomy support in sport and exercise settings has grown substantially in recent years, highlighting the need for a quantitative review to help establish its strength in predicting important psychological, motivational, and behavioral outcomes. It also remains unclear whether autonomy

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supportive behaviors are more beneficial across both individualist and collectivist cultures, and whether there are stronger associations in team or individual sports, and across different sports. Hence, in this paper we systematically review and meta-analytically synthesize the extant literature on the contextual supports of motivation for sport and exercise, focusing on autonomy support. In doing so, we provide a quantitative synthesis of the observed correlations in the literature and explore moderators of meta-analytic associations.

Autonomy support in sport and exercise settings

Self-determination theory (Ryan & Deci, 2000, 2017) is a multi-dimensional theory of human motivation that begins with the assumption that people are agentic beings with evolved propensities toward growth, mastery, and integrating new experiences with the self (Ryan & Deci, 2017). Deci and Ryan (2000) stipulate that these tendencies manifest to the extent that people can satisfy their basic psychological needs for autonomy, competence, and relatedness. *Autonomy* requires the inner endorsement of behavior (Deci & Ryan, 1987), whereby people perceive that their behaviors emanate from within the self as opposed to being externally directed (Deci & Ryan, 2000; Ryan & Connell, 1989). *Competence* requires succeeding at challenging tasks, developing a sense of mastery and efficacy, and attaining desired outcomes (Deci & Ryan, 2000; White, 1959). *Relatedness* requires a sense of mutual belonging, social connection, and feeling cared for by significant others (Baumeister & Leary, 1995).

Decades of research across several domains now support the benefits of satisfying these needs for optimal motivation, well-being, and performance (Niemiec & Ryan, 2009; Ryan & Deci, 2017, 2019; Slemp et al., 2018; Vansteenkiste & Ryan, 2013). Regarding well-being, Ryan and Deci (2019) argue that needs satisfaction supports a broad range of outcomes related to hedonia (feeling good) and eudaimonia (functioning well). Conversely, need frustration is a known contributor to poorly integrated motivation, ill-being, and non-optimal functioning (Ryan & Deci, 2017, 2019; Vansteenkiste & Ryan, 2013; Vansteenkiste et al., 2020). Consistent with the *organismic dialectic* principle (Deci & Ryan, 2000), which assumes that human tendencies towards need satisfaction require sustained nutriments and supports from the social-context, the contextual factors that facilitate the three needs have attracted substantial research attention. A key area in sport has focused on the coach behaviors that establish interpersonal climates to support basic needs, and amongst these behaviors, those that support autonomy are particularly central and widely studied (e.g. Coatsworth & Conroy, 2009; Gjesdal et al., 2019; Lopez-Walle et al., 2012; Pulido et al., 2014).

Within sport and exercise settings, autonomy support refers to an assortment of coach or instructor-led behaviors that collectively yield a climate of support, care, and understanding within the sport setting (Reeve, 2015). The provision of autonomy support will generally involve taking steps to (a) provide choices to the athletes under one's instruction, (b) provide athletes with a rationale for tasks and set limits, (c) acknowledge the athletes' feelings and perspectives, (d) provide non-controlling, competence-based feedback, (e) aspire to prevent ego involvement, and (f) avoid overt controls, such as the use of tangible punishments or rewards to prompt desired behaviors (Mageau & Vallerand, 2003). Additionally, structure and involvement were theorized to be separate but

complementary determinants of athlete competence and relatedness respectively (Mageau & Vallerand, 2003). More recent literature examining autonomy support, structure and involvement has argued that autonomy support is better conceptualized into two behavioral themes: participative and attuning behaviors (Aelterman et al., 2019; Curran et al., 2013; Delrue et al., 2019). Participative behaviors involve engaging in dialogue, including two-way communication, inviting input, and providing meaningful choices. Attuning behaviors, in contrast, aim to nurture interests and enjoyment by clarifying goals, providing meaningful rationales for tasks, accepting displays of negative affect, and seeking to understand the athletes' perspective. Irrespective of the conceptual definition used, autonomy support is thought to foster more agentic, volitional behaviors in sport because the provision of autonomy unburdens athletes from psychological constraints about how they ought to think, feel, or behave within the sporting setting – creating the perception that the self is the origin of behavior (Deci & Ryan, 1987). A controlling style, by contrast, is characterized by a 'coercive, pressuring, or authoritarian way … ' of imposing specific constraints on athlete thoughts, emotions, or behavior (Bartholomew et al., 2010, p. 194) where the external pressures become the perceived locus of behavior (Deci & Ryan, 1987).

Research on the provision of autonomy support in sport and exercise settings has grown substantially over the past decade, with studies uncovering a variety of potential benefits. For example, autonomy support has been found to predict sport enjoyment (Pulido et al., 2014) sport commitment (Mouratidis et al., 2010; Pedreno et al., 2015; Pulido, Sánchez-Oliva, Sánchez-Miguel, et al., 2018) and relate negatively to athlete burnout (Adie et al., 2012; Amorose & Anderson-Butcher, 2015). Moreover, autonomy support is generally positively associated with basic psychological need satisfaction (e.g. Gaudreau et al., 2016; Pulido et al., 2014), whereas controlling behavior is associated with basic psychological need frustration (e.g. Bartholomew et al., 2010, 2011). Further, dropout is a major issue, especially amongst young athletes and may be prevented by autonomy support (Pelletier et al., 2001; Sarrazin et al., 2002). This is particularly important given that keeping young people in sport enables them to reap the psychological and physical health benefits of sport participation (Fraser-Thomas et al., 2005; Steptoe & Butler, 1996), including a sense of belonging (Allen, 2006), life satisfaction (Vilhjalmsson & Thorlindsson, 1992), and personal development (Fraser-Thomas et al., 2005). In addition, it is widely documented that athletes demonstrate higher mental and physical well-being than non-athletes (Snyder et al., 2010), and also display higher levels physical exercise (Hebert et al., 2015), which tends to carry forward into young adulthood (Kjønniksen et al., 2009). Hence, autonomy support is thought to be a contextual motivational precursor towards keeping athletes in sport and thus keeping them physically active.

Autonomy support and internalized motivation

A further benefit of autonomy support, and, in turn, need satisfaction, is that it likely yields higher quality motivation to participate in the sport. Unlike other theories of motivation that focus primarily on the quantity or intensity of motivation, types of motivation within SDT are distinguished by their quality (Ryan & Deci, 2000), differentiating between *extrinsic motivation* (i.e. engaging in activities for instrumental reasons, whereby activities are

motivated by a means-end structure) and *intrinsic motivation* (i.e. seeking to do an activity because it is enjoyable), and *amotivation*, which is a state of non-regulation that signifies the absence of motivation. Moreover, several different types of extrinsic regulatory styles are specified within SDT that differ in the degree to which they are autonomous or controlled. *External regulation* is the most controlled form of extrinsic motivation and describes behaviors motivated purely by external contingencies such as obtaining rewards or avoiding punishments. *Introjected regulation* is another controlled motivation that involves internal pressure placed on the self, typically to serve an avoidance of shame or guilt, or to maintain one's self-esteem. *Identified regulation* describes a more autonomous motivation and involves engaging in a behavior because one finds value and meaning in it. Finally, *integrated regulation* represents the most internalized and autonomous form of extrinsic motivation. It occurs where a regulation or value that originated externally is assimilated and held to be congruent with the broader self. The external and introjected forms of regulation are described as controlled (i.e. nonself-determined) motivation, whereas the identified, integrated, and intrinsic motives represent autonomous (i.e. self-determined) motivation (Howard et al., 2017; Ng et al., 2012; Ryan & Deci, 2017).

A central feature of the SDT continuum is the process of *internalization*, which describes a natural tendency for people to transform controlled motivations into more autonomous ones that are fully integrated within the self (Ryan, 1995). Because autonomy support allows for more volitional, self-regulatory behaviors within the sport settings, athletes can then more freely engage in exploratory, autonomous behavior – likely advancing learning, skills, and competence (Guay et al., 2001) – and thus facilitate their ability to find value or enjoyment in goals that were otherwise controlled. Hence, autonomy support should aid the internalization process in athletes' motivation for sport, which would be reflected by progressively stronger positive associations with the more internalized, autonomous forms of motivation described within SDT, as well as negative associations with amotivation (Slemp et al., 2018).

Some studies support these relations (e.g. Amorose & Anderson-Butcher, 2015; Fenton et al., 2014; Pulido et al., 2014; Reynolds & McDonough, 2015), yet the exact magnitude of the relation between autonomy support and important well-being outcomes has not been established, and a quick inspection of the literature reveals substantial heterogeneity in the reported relations across studies. As examples, autonomy support associations with athlete external regulation vary from negative $r = -.27$ (Vlachopoulos et al., 2011) to positive $r = .30$ (Reynolds & McDonough, 2015). These correlations are in the medium to large range respectively (see effect size distribution in Gignac & Szodorai, 2016). By contrast, relations with intrinsic motivation vary from near zero (Almagro et al., 2010; Isoard-Gautheur et al., 2012) to strongly positive ($r = .56$; Reynolds & McDonough, 2015). Broad ranges can also be observed for autonomy, competence, and relatedness needs. Meta-analysis will help resolve these inconsistencies, thus informing the literature about the aggregate strength of associations between autonomy support and athlete motivational, well-being, behavioral outcomes (e.g. performance and engagement), and climate factors, which we examine in this encompassing review, ultimately informing whether the provision of autonomy support is likely to have its intended benefits.

Moderators of meta-analytic associations

The heterogeneity observed in prior literature suggests the existence of possible moderating factors contributing to variability in effects across studies. Herewith we examine two potential moderators that are theoretically plausible. First, autonomy is regarded as a universal psychological need within SDT that exists independent of the cultural setting (Chirkov et al., 2003). If true, then contextual supports for autonomy should be equally beneficial irrespective of national culture (Chirkov, 2009). We thus examine whether correlations with basic needs and internalized motivation differ as a function of whether samples were drawn from countries that vary along the Hofstede (2001) cultural dimension of individualism-collectivism. Individualism prevails in most Western societies and describes a cultural norm of valuing self-sufficiency and independence from others (Triandis, 1989). Collectivism prevails in most East Asian societies, and describes a cultural norm of interdependence, in which group priorities take precedence over the self (Markus & Kitayama, 1991). We focus on this cultural dimension because prior disputes about the universality of autonomy have centered on whether cultural values for autonomy are opposed to those that prioritize group cohesion and interdependence (Iyengar & Lepper, 1999; Oishi, 2000), which are commonly associated with collectivism. Other reviews of related SDT literatures have also shown little evidence of moderation along the dimension of individualism-collectivism (e.g. Slemp et al., 2018; Yu et al., 2018).

Second, the provision of autonomy support has been found to be higher in coaches of individual sports when compared to coaches of team sports, who have been found to be more controlling (Delrue et al., 2019). Moreover, in experimental research, Reynders et al. (2019) found stronger effects for individual as compared to team sports. Thus, we examine the type of sport (i.e. team versus individual) as a moderator of athlete perceptions of coach autonomy support.

The present study aims and hypotheses

Whilst a vast literature exists on the correlates and consequences of autonomy support in sport and exercise settings, no attempt has yet been made to systematically combine and quantitatively aggregate this literature. While Vasconcellos et al. (2020) recently published a review on SDT in Physical Education (PE) settings, there has not been a study that examines autonomy support in sport and exercise settings. Organized leisure-time sport settings are different from PE settings in that they generally involve voluntarily participation, whereas PE is often an obligatory aspect of a school curriculum. Thus, in conducing our review, we had two primary aims. First, we aimed to provide a basic overview of the SDT research in this literature, providing broad descriptive evidence of various correlates and potential consequences of coach autonomy support, as well as their strength of association with important athlete outcomes. Our second aim was to examine possible moderators that could affect correlation magnitudes in this literature. Based on the prior synthesis, we hypothesize that:

H1: Autonomy support will exhibit meta-analytic associations consistent with the internalization of motivation regulations in athlete motivation. That is, it should be most strongly and positively associated with motivations that are fully internalized and autonomous (i.e.

intrinsic motivation), less related to external regulation, and negatively associated with amotivation.

H2: Autonomy support will exhibit main effect associations consistent with SDT propositions: positive with basic needs, well-being, and negatively with ill-being and need frustration. We expect that autonomy support will predict all three basic needs—not just autonomy—because self-governed behaviors made possible by autonomy support allow people to seek out and find fulfilment across all three needs, including competence and relatedness (Bartholomew et al., 2010, 2011; Ryan & Deci, 2017; Slemp et al., 2018).

H3: Correlations with basic needs and internalized motivations will not vary as a function of the national culture of the study population.

H4: Correlations will be moderated by type of sport (e.g. team versus individual) with individual sports showing stronger associations.

Method

Search strategy

In establishing the search strategy, the first author used insights gleaned from consultation with a librarian for closely related projects, helping to ensure the search strategy was maximally effective. We also followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher et al., 2009) for the present study. Thus, in October 2020 we sourced relevant records through 7 electronic databases: PsycINFO, MEDLINE, SPORTDiscus, CINAHL, Web of Science, ERIC, and Scopus. We imposed no date restraints. We used a set of search terms that were designed to capture records relating to autonomy support, which yielded 11,192 initial records, from which we only included studies conducted in sport settings. The full set of search terms can be found in Appendix A and our PRISMA flow diagram can be found in Appendix B of our supplemental file.

We also examined other sources for relevant records, including reference lists from Cochrane library sources, and reference lists of key self-determination theory (SDT) books, literature reviews, empirical papers, and book chapters. These processes led to the identification of a further 2,588 relevant records. Thus, a total of 13,780 records were screened, after which we were left with 8,273 relevant items after duplicates were removed. Using the titles and abstracts, a further 6,383 records were screened-out due to obvious irrelevancy, leaving 1,890 for full-text examination. Of these, 1,770 were eliminated based on the eligibility criteria (specified below), leaving 120 sources. Finally, because duplicated samples in meta-analyses can lead to an overcorrection for sampling error (Schmidt & Hunter, 2015; Wood, 2008) and violates the assumption of statistical independence, the final step of our process was to examine the 120 samples for duplication across sources using the heuristic provided by Wood (2008). Using this procedure, which included comparisons of study characteristics, sample characteristics, constructs, measures, and study effects, we eliminated one further record, leaving us with a total of 119 sources (111 published) comprising 131 samples ($N = 38{,}844$) for inclusion in the meta-analysis.

Eligibility criteria

Each study was included in the meta-analysis if it satisfied the following three criteria: (a) it investigated autonomy support in a sport or exercise setting distinct from physical

education settings; (b) the study measured self-rated, athlete-perceived or observer-rated autonomy support; and (c) it provided a correlation between autonomy supportive behavior and at least one relevant criterion variable (e.g. indices of athlete motivation or basic needs, well-being or distress, indicators of athlete functioning or climate, and other instructor or peer-related behaviors).

Coding procedure

The coding process was primarily completed by the third author using a systematic coding sheet and to determine the accuracy of the coding process, a subset of 40 studies were independently recoded by the first author. An overall accuracy check showed 95.50% agreement between coders. For nominal variables, we also calculated Cohen's (1960) Kappa between the initial and secondary ratings. Results suggest solid agreement across coding categories (.72–1.00). For continuous variables, a two-way, absolute, single measures intraclass correlation coefficient (ICC; McGraw & Wong, 1996) was computed. Resulting ICCs showed high-level agreement (range: .97–1.00). Data codes included (a) the correlation coefficient between autonomy support and the criterion variable; (b) the name of the criterion variable; (c) the sample size; (d) the reliability of the autonomy support measure (R_{xx}); (e) the reliability of the criterion measure (R_{yy}); (f) the autonomy support measure used; (g) the country where the study was conducted; (h) whether the study was published; (i) the context in which the sport or exercise took place (e.g. university, competitive school sport); (j) the standard of the athletes (e.g. high performance, mixed); (k) the mean age of the participants; (l) the sport type (e.g. team, individual); (m) the actual sport (e.g. soccer); (n) whether the study occurred in a sport setting or an exercise setting; and (o) the time interval (in months) between the predictor and the criterion variable measurements (if any).

Data transformations

Our coding procedure involved some transformations of the data. Specifically, we used the procedure specified by Schmidt and Hunter (2015) to aggregate the correlations reported within studies when the studies reported multiple non-independent correlations between facets of autonomy support or facets of a criterion. For example, some studies (e.g. Almagro et al., 2010; Banack et al., 2011) provided correlations between autonomy support and the three individual facets of intrinsic motivation (i.e. intrinsic motivation *to know*, *towards accomplishment*, and *to experience stimulation*) using the Sport Motivation Scale (SMS; Brière et al., 1995), but did not report a correlation with overall intrinsic motivation. Thus, in this case, we used the intercorrelations between these three facets to arrive at composite correlations between autonomy support and *intrinsic motivation*. We followed the same procedure to aggregate within study correlations for *autonomous motivation* (combining identified and intrinsic motivations), *controlled motivation* (combining introjected and external regulations), and overall *basic needs satisfaction* and *basic needs frustration* (combining autonomy, competence, and relatedness satisfaction and frustration, respectively). In cases where studies did not report intercorrelations between variable facets, we emailed authors to obtain them. In the few instances

where this failed, we used an estimated intercorrelation of $r = .50$ to generate the composites.

Where greater than three studies were available, we also calculated the correlations between autonomy support and each sub-dimension of any higher-order construct. Finally, on the basis that facets within a scale or a higher-order construct are not-orthogonal, we calculated Mosier (1943) reliabilities for composite constructs. Mosier reliabilities require the intercorrelations between facets of composites. In the few instances where these were not available, we used the mean of the reliabilities for that variable. In the interest of scientific transparency, we created a project page on the Open Science Framework where we make available all study materials used in the present study (e.g. data-sets, analytic scripts; see https://osf.io/a6e4u).

Meta-analysis procedure

We used the procedures recommended by Schmidt and Hunter (2015) in conducting our meta-analysis, using the 'psychmeta' package of R (Dahlke & Wiernik, 2019) and the R-Studio interface. Thus, we calculated sample-size weighted mean observed correlations between autonomy support and each criterion, and then disattenuated correlations for error of measurement in both the predictor and the criterion. To do this, we used the reliability coefficients that were reported in the included studies, which were available in most cases. When some reliability coefficients were missing for a variable, we constructed artifact distributions from the reliability information that was described in the included studies (See Appendix C for descriptives of our reliability distributions). All analyses were conducted using the unbiased sample variance estimator available in psychmeta, which leads to more accurate results with conservative confidence intervals (CIs), particularly when *k* is low (Dahlke & Wiernik, 2019).

The Schmidt and Hunter (2015) psychometric meta-analysis approach is based on the random effects model, which estimate mean effect sizes under the assumption that effect size variability is caused by either study artifacts or moderating factors. Random effect models are known to lead to more accurate and generalizable population effect size estimates than fixed effect models, which assume homogeneity of effect parameters – an assumption unlikely to hold in applied settings (Hunter & Schmidt, 2000; Schmidt & Hunter, 2015). Random effect meta-analyses also yield more realistic and conservative confidence intervals (CIs; Field, 2003; Hunter & Schmidt, 2000; Kisamore & Brannick, 2008). We used a 95% CI to evaluate the precision of each true-score correlation (ρ). When this encompassed 0, we concluded that the relation between the two constructs was not significant. To assess the magnitude of the true-score correlations, we used benchmarks reported in Gignac and Szodorai (2016), which were developed from a synthesis of 708 meta-analytically derived correlations in individual differences research. True score correlations of $\rho = .15$, .25, and .35 roughly corresponded to the 25th, 50th and 75th percentiles, respectively. We thus used these as benchmarks for the lower bound of small, moderate, and strong correlation effect size magnitudes for the present study.

We evaluate heterogeneity in three ways. First, we report the 80% credibility interval (CV), which affords an estimate of heterogeneity distributed around each effect size. The CVs suggest that 80% of the correlations in the in the distribution of

true-score correlations lie within this range. Second, we report SD_ρ which provides indication of cross-study heterogeneity. Finally, we report I^2 (Higgins et al., 2003), which provides an estimate of the percentage of variance in each effect size that is not explained by sampling error or measurement error. Higgins et al. (2003) tentatively assigned benchmarks of low, moderate, and high to values of 25%, 50%, 75% for I^2, which we applied in the current study. We examined moderators whenever I^2 was at least moderate. Based on recommendations of Schmidt (2017), subgroup moderation analyses were given preference over meta-regression, and were explored by conducting a string of meta-analyses across the different sub-groups of each moderator. We concluded that variables depended on a moderator if the CIs across the different levels of each moderator did not overlap (Borenstein et al., 2009). If only continuous data were available (e.g. mean sample age, time-lag), we ran these analyses using meta-regression.

We calculated an effect only in cases where at least three studies were available for a meta-analytic association. If a study reported both cross-sectional and time-lagged correlations (e.g. Isoard-Gautheur et al., 2012) we only used the most distant lagged correlation, consistent with the causal direction implied by this literature. That is, autonomy support is typically treated as an antecedent to motivational processes, well-being, and behavior in sport settings (e.g. Mageau & Vallerand, 2003; Ryan & Deci, 2017). This procedure also had the benefit of reducing common-method variance in our data (Podsakoff et al., 2003). We summarize our main effect and moderator analyses findings with 11 pieces of information: (a) k = number of studies used to calculate each effect, (b) N = combined sample size, (c) r = the 'bare bones' meta-analytic correlation before artifact corrections are applied (Schmidt & Hunter, 2015), (d) SD_r = the observed standard deviation (e) SD_{res} = residual standard deviation, (f) ρ = autonomy support correlation corrected for sampling and measurement error (i.e. the true score correlation), (g) SD_ρ = the standard deviation of ρ, (h) SD_{rc} = the observed standard deviation of artifact corrected correlations, (i) 95% CI = 95% confidence interval (CI) for true score correlations, (j) 80% CV = 80% credibility interval, (k) I^2 = variation in observed correlations that cannot be accounted for by sampling and measurement error (represented as a percentage).

Results

Overall main effects: empirical consequences of coach autonomy supportive behavior

Table 1 presents meta-analytic correlations between coach supports for athlete autonomy and the different consequences in this literature. We grouped our reporting of these relations according to those coming under (a) athlete motivation and basic needs, (b) athlete well-being, ill-being, and functioning, as well as (c) variables pertaining to sports climate and other coach behaviors.

Motivation and basic needs

Per Table 1, coach autonomy support exhibited strong positive meta-analytic correlations with autonomous motivation, including intrinsic motivation, as well as

integrated and identified regulations. By contrast, near-zero and non-significant correlations were observed with controlled motivation, except introjected regulation which showed a weak positive relationship. A weak negative association was observed with amotivation.

For basic psychological need satisfaction, strong positive meta-analytic correlations were observed, including for athletes' autonomy and relatedness needs, whereas the association with competence satisfaction was in the upper moderate range. By contrast, moderate to strong negative associations were found for autonomy, competence and relatedness frustration.

Athlete well-being, ill-being, and functioning

Notable in Table 1 is that coach autonomy support displayed strong positive associations with indices of athlete general well-being, positive affect and subjective vitality, whereas life satisfaction and self-esteem showed moderate positive associations. In contrast, we observed moderate negative meta-analytic correlations between coach autonomy support and all illbeing indices except for general illbeing and anxiety which exhibited small negative effects. Overall, correlations with indices of well-being were generally stronger than those observed with indices of ill-being. Moderate to strong positive correlations were generally observed for athlete functioning, including engagement, effort, teamwork, and physical activity. The association with athlete performance was in the small range.

Sports climate and coach behaviors

Table 1 shows very strong positive correlations between coach autonomy support and sports climate and other coach behaviors, with correlations generally exceeding $\rho = .70$. This includes correlations with task-involving climate, competence supportive coach behaviors, structure, relatedness supportive coach behaviors, and involvement. In some instances, the CI of these correlations encompassed 1, indicating a lack of discriminant validity. Strong negative associations were generally observed between coach autonomy support and coach behaviors that thwarted athlete autonomy, competence, and relatedness, although these were notably smaller.

Moderator analyses

We next explored whether our correlations depended on a moderator when sufficient heterogeneity was present. We predicted that correlations would remain relatively stable across cultures (H3), based on the premise that autonomy support is universally beneficial in fostering internalization and basic need satisfaction (Chirkov et al., 2003; Deci et al., 1994). To run this analysis, we used moderator subgroup analyses, where we coded samples as individualist or collectivist based on their percentile rank (>50 was considered individualist; Hofstede, 2001). Using this procedure, we found no evidence of moderation and both cultures tended to yield effects in the strong range with overlapping CIs in each case.

Next, we considered type of sport (i.e. team v individual sport) as a moderator (H4). While autonomy support was slightly more strongly associated with need satisfaction in individual than team sports (*team*: $k = 20$, $N = 5{,}113$, $\rho = .48$ [CI .41, .56]; *individual*: k

Table 1. Meta-analyzed correlations with coach autonomy support in sport settings.

Variable	*k*	*N*	*r*	SD_r	SD_{res}	ρ	SD_{r_c}	SD_ρ	95% CI	80% CV	I^2 (%)
Coach Autonomy Support											
Athlete Motivation and Basic Needs											
Autonomous motivation	66	18,968	.32	.16	.15	.39	.19	.18	[.34, .43]	[.16, .61]	86
Intrinsic motivation	30	8,875	.32	.12	.10	.38	.14	.12	[.32, .43]	[.22, .54]	76
Integrated regulation	3	687	.37	.06	.00	.42	.07	.00	[.25, .59]	[.42, .42]	0
Identified regulation	21	5,787	.31	.15	.14	.38	.19	.18	[.29, .47]	[.15, .62]	86
Controlled motivation	42	10,548	.01	.14	.12	.02	.17	.15	[−.04, .07]	[−.18, .21]	80
Introjected regulation	19	5,441	.13	.19	.18	.16	.23	.22	[.04, .27]	[−.14, .45]	90
External regulation	19	5,532	−.00	.17	.16	−.01	.20	.19	[−.10, .09]	[−.26, .25]	87
Amotivation	22	6,475	−.16	.16	.15	−.19	.19	.18	[−.28, −.10]	[−.43, .05]	87
Basic psychological need satisfaction (composite)	55	17,527	.50	.15	.14	.57	.17	.16	[.52, .61]	[.36, .78]	89
Autonomy satisfaction	45	13,887	.46	.17	.16	.56	.21	.20	[.50, .62]	[.30, .81]	90
Competence satisfaction	53	15,080	.28	.13	.12	.34	.16	.14	[.29, .38]	[.15, .52]	81
Relatedness satisfaction	44	13,305	.39	.14	.13	.45	.16	.15	[.40, .50]	[.26, .64]	85
Basic psychological need frustration (composite)	10	3,081	−.26	.25	.24	−.29	.28	.27	[−.49, −.09]	[−.67, .09]	95
Autonomy frustration	6	2,012	−.26	.16	.15	−.31	.19	.18	[−.50, −.11]	[−.57, −.05]	95
Competence frustration	5	1,624	−.23	.24	.23	−.26	.28	.27	[−.61, .08]	[−.68, .15]	95
Relatedness frustration	4	1,385	−.31	.17	.16	−.36	.20	.19	[−.67, .04]	[−.66, −.05]	92
Athlete Well-Being, Ill-Being & Functioning											
General well-being	11	3,622	.41	.10	.08	.48	.11	.10	[.40, .55]	[.35, .61]	73
Positive affect	13	3,119	.34	.12	.11	.40	.14	.12	[.31, .48]	[.23, .57]	77
Life satisfaction	9	2,814	.24	.09	.07	.27	.10	.08	[.19, .34]	[.15, .38]	65
Subjective vitality	14	4,605	.30	.11	.09	.35	.12	.11	[.28, .42]	[.21, .49]	76
Self-esteem	14	3,397	.23	.11	.10	.28	.14	.11	[.20, .35]	[.12, .43]	71
General ill-being	4	1,126	−.15	.12	.10	−.18	.14	.12	[−.40, .04]	[−.38, .02]	75
Negative affect	9	2,144	−.26	.20	.19	−.30	.23	.22	[−.48, −.12]	[−.61, .01]	91
Burnout	14	4,308	−.24	.18	.18	−.27	.21	.20	[−.39, −.15]	[−.54, .00]	91
Depression	4	1,207	−.25	.13	.11	−.30	.15	.13	[−.53, −.06]	[−.51, −.08]	80
Anxiety	3	1,012	−.10	.08	.06	−.12	.10	.08	[−.38, .13]	[−.27, .02]	57
Resilience/persistence	5	1,246	.26	.12	.11	.31	.14	.13	[.13, .49]	[.12, .50]	76
Effort	4	1,237	.33	.18	.17	.39	.22	.21	[.05, .74]	[.06, .73]	92
Performance and achievement	15	2,843	.18	.13	.11	.21	.16	.13	[.13, .30]	[.03, .39]	72
Teamwork	4	1,265	.40	.13	.11	.45	.14	.12	[.22, .68]	[.25, .66]	77
Physical activity	10	2,133	.22	.10	.08	.27	.13	.10	[.18, .36]	[.14, .41]	57
Past physical activity	4	1,008	.31	.03	.00	.36	.04	.00	[.29, .42]	[.36, .36]	0
Engagement	19	5,209	.31	.16	.15	.37	.20	.18	[.27, .47]	[.13, .61]	87

(*Continued*)

Table 1. Continued.

Variable	*k*	*N*	*r*	SD_r	SD_{res}	ρ	SD_{r_c}	SD_ρ	95% CI	80% CV	I^2 (%)
Disengagement	7	2,170	−.14	.17	.16	−.17	.21	.20	[−.37, .02]	[−.46, .11]	88
Sports Climate & Coach Behaviors											
Task-involving climate	5	2,912	.63	.31	.28	.89	.43	.39	[.35, 1.00]	[.29, 1.00]	82
Ego-involving climate	7	4,098	−.31	.20	.19	−.45	.30	.28	[−.72, −.18]	[−.85, −.05]	89
Athlete-coach relationship quality	4	856	.63	.14	.13	.69	.16	.15	[.44, .94]	[.45, .93]	87
Coach controlling behavior	38	12,549	−.29	.15	.14	−.37	.19	.18	[−.44, −.31]	[−.60, −.14]	83
Competence support	16	4,978	.62	.17	.16	.76	.21	.20	[.65, .88]	[.49, 1.00]	90
Structure	8	2,162	.60	.13	.12	.74	.16	.15	[.60, .88]	[.53, .95]	83
Relatedness support	23	8,754	.61	.21	.17	.86	.29	.24	[.73, .98]	[.54, 1.00]	67
Involvement	4	907	.69	.09	.07	.86	.11	.09	[.69, 1.00]	[.72, 1.00]	64
Autonomy thwarting	4	939	−.35	.34	.33	−.41	.40	.39	[−1.00, .22]	[−1.00, .23]	96
Competence thwarting	5	1,369	−.21	.34	.34	−.26	.41	.40	[−.76, .25]	[−.87, .36]	97
Relatedness thwarting	6	1,426	−.26	.35	.34	−.33	.43	.42	[−.78, .12]	[−.95, .29]	96
Athlete Demographics											
Age	6	804	−.11	.09	.03	−.12	.10	.03	[−.22, −.02]	[−.16, −.08]	8
Experience	3	445	−.00	.06	.00	−.00	.06	.00	[−.16, .16]	[−.00, −.00]	0

Note: *k* number of studies in the analysis, *N* combined number of participants, *r* sample size weighted mean observed correlation, SD_r observed standard deviation of correlations, SD_{res} = residual standard deviation of correlations after accounting for sampling error and measurement error, ρ estimate of the true score correlation, $_{rc}$ = observed standard deviation of corrected correlations (r_c), $SD\rho$ standard deviation of estimated true score correlation, CI confidence interval, CV credibility interval, I^2 variance not attributable to sampling and measurement error. Correlations corrected using artifact distributions.

= 15, $N = 4{,}880$, ρ = .53 [CI .42, .65]) and with autonomy satisfaction (*team*: $k = 15$, $N = 4{,}103$, ρ = .41 [CI .33, .50]; *individual*: $k = 13$, $N = 3388$, ρ = .47 [CI .39, .55]), there was overlap in the CIs in each case, indicating no moderation.

We finally examined some exploratory moderators for which we had no specific hypotheses (i.e. whether effects varied depending on measurement time-lag, athletes' age, competitive standard, or whether the study took place in a sport or exercise setting). Using meta-regression, we found that the autonomy support associations to identified regulation ($k = 21$, $SE = 0.030$, $\beta = -0.080$, CI = [−0.1385, −0.0214]), as well as autonomy ($k = 45$, $SE = 0.014$, $\beta = -0.032$, CI = [−0.0605, −0.0042]), competence ($k = 54$, $SE = 0.013$, $\beta = -0.039$, CI = [−0.0648, −0.0132]), and relatedness ($k = 44$, $SE = 0.011$, $\beta = -0.024$, CI = [−0.0454, −0.0028]) satisfaction decreased as a function of time-lag (in months) between the autonomy support to criterion measurements. We found no evidence of moderation based on athletes' age, the competitive standard of the sport, or whether the study took place in a sport or an exercise context.

Publication bias

Our next step was to examine these results for evidence of publication bias, which we considered in two ways. First, to examine whether published and unpublished studies reported different correlation magnitudes across the variables in this literature, we report separated correlations based on studies that appeared in peer-reviewed journals against all other studies (doctoral dissertations and theses, conference presentations). We did this whenever there were greater than three published and unpublished studies for a variable. For space reasons, results are shown in our supplemental file in Appendix D. Results showed little evidence for publication bias with very similar results observed between published and unpublished sources, and at least some or complete overlap in the CIs in each case.

We next considered publication bias using Egger's regression test of funnel plot asymmetry (Egger et al., 1997), which yields evidence of inflated effects in smaller studies (see Appendix E). This test regresses the standard normal deviate for each observed correlation against the estimate's precision. The intercept of the regression line quantifies the asymmetry, with large and significant deviations from 0 suggestive of asymmetry and thus missing literature. We only used this approach when at least 10 effect sizes were available for a meta-analytic correlation, as analyses for publication bias have limited power (Kepes et al., 2012) and can be affected by outliers. We also ran these analyses using contour-enhanced funnel plots in which z-transformed effects are plotted against standard errors. Symmetry of the zero-centered plots can be scrutinized with the visual-aid of contour lines that reflect different levels of significance: $p < .01$ (grey zone), $p < .05$ (orange zone), $p < .10$ (red zone), and $p > .05$ (white zone). If bias is present, plots generally demonstrate a pattern of missing weak effects that are near zero (i.e. the white zone) among the studies with high standard errors. Using these procedures, results show no evidence of bias with all plots relatively symmetrical and Egger's regression test not significant for each plot. Overall, we conclude that publication bias is not having a large impact on correlation effect sizes in this literature, and our results are unlikely to be positively or negatively biased.

Discussion

The present study estimated meta-analytic associations between autonomy support and its correlates in 131 independent samples in sport and exercise settings. Due to the observed heterogeneity of effects, moderators of these associations were also examined. In aggregate, our results offer some support for propositions based on SDT and advance research by showing that autonomy support is a robust predictor of basic psychological needs for autonomy, competence, and relatedness, autonomous motivations to participate in sport or exercise, as well as athlete well-being more broadly. We also show that effects remain relatively stable across cultural groups, types of sport (i.e. team or individual), varying athlete ages, competition standard, and whether studies occurred in a sport or exercise setting. In the sections that follow, we expand on our contributions in more detail, examining theoretical and practical implications that emerged from our meta-analysis, as well as limitations with our approach.

Theoretical and empirical contributions

Supporting our first hypotheses (H1), autonomy support exhibited meta-analytic associations consistent with the internalization process of athlete motivation. That is, associations with coach autonomy support progressively increased as a function of degree to which the motivation criteria were internal, with the strongest correlations observed for autonomous forms of motivation, near zero correlations observed with controlled forms of motivation, and negative associations observed with amotivation. Our meta-analysis thereby confirms the pattern of relations consistent with the proposition based on SDT that autonomy support is an important predictor of autonomous motives to participate in sport and exercise. Our findings were also consistent with broader theoretical propositions based on SDT (H2), confirming strong positive associations of autonomy support to athlete basic need satisfactions and indices of well-being, and moderate to strong negative associations with basic need frustrations and athlete distress criteria. Our results help to resolve some of the observed heterogeneity in the athlete motivation literature and demonstrated that coach autonomy support is consistently related to desirable outcomes in sport and exercise settings.

In line with previous meta-analyses in different contexts (Slemp et al., 2018; Vasconcellos et al., 2020) and consistent with our predictions (H3), a contribution of our meta-analysis was the lack of evidence for a moderation effect across individualist versus collectivist cultures; both cultures yielded strong effects of autonomy support with motivational processes with overlapping CIs in each case. This finding is consistent with claims based on SDT regarding the universal benefits of autonomy on human wellness and positive functioning (Chirkov et al., 2003; Ryan & Deci, 2017). That is, because autonomy is positioned as a central and universal human psychological need (Ryan & Deci, 2017), it should be positively related to motivation and basic needs across all cultures, a conclusion for which our findings lend some support. These findings are also in opposition to prior claims that the provision of autonomy would be opposed to values that prioritize group cohesion and interdependence that are common in collectivist cultures (Iyengar & Lepper, 1999; Oishi, 2000), which, if true, would suggest the effects of autonomy support on motivation and basic needs would approximate zero in collectivist cultures.

Our meta-analysis reveals that this is not the case and instead, autonomy support is likely to go hand in hand with positive benefits across diverse cultural groups. However, while this finding is promising and consistent with predictions based on SDT, it is nevertheless worth noting there were greater numbers of individualist than collectivist samples included in our meta-analysis. Thus, we suggest future research could build upon our findings to confirm our results as more studies are completed in collectivistic samples.

Further notable findings of our meta-analysis were the very strong observed correlations between autonomy support and the other need support and sport climate related variables (i.e. competence support, relatedness support, structure, and involvement). In some cases, the corresponding CIs of the meta-analyzed correlations encompassed 1, pointing to a potential lack of discriminant validity in measurement, despite the strong conceptual underpinnings that underlie these different ways to engender support for basic psychological needs (Ryan & Deci, 2017). We initially expected that this may be due to the way these variables have been measured historically, with some sport- and exercise-based autonomy support measures containing items that arguably capture other need supportive coach behaviors. For example, Deci's (2001) Sport Climate Questionnaire, which is one of the most widely used scales to measure autonomy support in sport and exercise settings, contains items that share some similarities to relatedness support (e.g. 'I feel able to share my feelings with my coach') and competence support (e.g. 'My coach conveyed confidence in my ability to do well at athletics'), potentially inflating the strength of associations between autonomy support and coach behaviors that support relatedness and competence (Van den Broeck & Slemp, in press).

Authors of more recent scales have made considerable efforts to discriminate coach need supportive behaviors into discrete facets that are distinct from autonomy support (e.g. Pulido, Sánchez-Oliva, Leo, et al., 2018; Rocchi et al., 2017; Shen et al., 2010). Yet, it is possible that the same issue may persist with these newer scales. For example, the Interpersonal Behavior Scale (IBS; Shen et al., 2010), which distinguishes between autonomy support and competence support, has shown bivariate correlations between facets that range from $r = .67$ (Liu et al., 2018) to .73 (Liu et al., 2020), all in the very strong range. Similar strength correlations are typically observed for other measures, including the Situation in Sport Questionnaire (SSQ; Delrue et al., 2019), Wellborn's (1988) Teacher as Social Context Questionnaire (TASCQ; e.g. Curran et al., 2013; McDavid, 2015), and Pelletier et al.'s (1995) Coach's Interpersonal Style Questionnaire (CIS-Q; e.g. Pope & Wilson, 2015). We suggest further work is needed to establish ways these measures can more reliably empirically distinguish autonomy support from other conceptually distinct, yet closely related coach need supportive behaviors, which remains a direction for ongoing work.

Practical implications

While caution should be exercised in making causal inferences based on the findings in the present study, our results nevertheless show that the provision of autonomy support is consistent with individual satisfaction for basic psychological needs, autonomous motivation, and well-being in sport and exercise settings. Thus, finding ways to enhance coach autonomy supportive behavior may be a way to engender more of these positive qualities in athletes and sport and exercise participants. One way to test

this could be through the development and implementation of training programs that are designed to enhance autonomy supportive behavior in coaches. To date there is a dearth of research that has comprehensively evaluated such programs in sport and exercise samples (Raabe et al., 2019), though emerging research across a range of sports suggests such programs may be effective (Langan et al., 2015; Langdon et al., 2015; Reynders et al., 2019). Furthermore, available literature from closely related research domains has suggested potential causal benefits (Raabe et al., 2019). For example, experimental studies from the physical education literature suggest that training can be effective in yielding changes in teacher autonomy supportive behavior, which has corresponding benefits for student motivation, basic psychological needs, and engagement (e.g. Cheon et al., 2018; Cheon & Reeve, 2013; Raabe et al., 2019). Insights from these studies along with recommendations from Slemp et al. (2021) on designing effective need supportive interventions may help inform future practice and research for interventions designed for sport and exercise settings. Future research that comprehensively evaluates the causal benefits of coach autonomy supportive training will help to confirm whether corresponding benefits exist in sport and exercise settings, as has been shown in comparable literatures (e.g. Raabe et al., 2019; Gillison et al., 2009).

Another way our results may confer practical utility is by informing coach recruitment processes, such that efforts can be made to engage coaches who are more autonomy supportive from the outset. We anticipate that informing coach recruitment will be particularly useful in more formal and competitive sport settings where more resources are placed in the recruitment and selection of elite coaches. Provided some coaches tend to be characterized by high autonomy supportive and low controlling behavior profiles, which is considered optimal (Haerens et al., 2018), coach recruitment strategies could consider factoring these motivational profiles into their selection criteria, thereby creating environments that are maximally conducive to basic psychological needs, autonomous motivation, and well-being from the outset. In cases where coaches display less desirable profiles, this practice may also be informative in identifying future coach training needs to enhance coach autonomy supportive behavior.

Methodological limitations of the included studies

Based on the studies included in the meta-analysis, we offer several suggestions for future research so that threats to validity can be minimized and important questions can be addressed. First, the majority of the studies we reviewed were cross-sectional (76.34%), with fewer studies reporting relations over time (19.85%). Cross-sectional studies are limited insofar as they are the most affected by common-method variance (Podsakoff et al., 2003), or transient-occasion measurement factors (Spector, 2019), which can artificially impact correlations in a literature. Future studies should consider introducing temporal separation in measurement via prospective (different variables assessed at each occasion) methods (e.g. Gaudreau et al., 2016; Gjesdal et al., 2019; Jõesaar et al., 2012; Pelletier et al., 2001) or longitudinal (all variables assessed at each occasion) methods (e.g. Adie et al., 2012), which would help to minimize such biases in research. Indeed, studies utilizing these methods have found that autonomy support predicts beneficial outcomes over time, including athlete intrinsic motivation after a year (Jõesaar et al.,

2012), and well-being across two competitive seasons (Adie et al., 2012). Taken together, these findings lend support to claims in the SDT literature that autonomy support is an antecedent to basic psychological needs, wellbeing, and autonomous motivation for sport, yet further research is required to replicate these findings in a variety of sport settings. While these approaches do not necessarily allow for strong causal inferences, they are useful in examining time-lagged relationships after controlling for stable individual difference factors, and can also be used to establish temporal precedence in observed relationships. Multi-wave longitudinal designs with appropriate statistical models to test lagged relationships, as captured in models of panel data (e.g. Hamaker et al., 2015; Zyphur et al., 2020) might offer further advanced techniques that allow stronger causal inferences, thus complementing existing literature.

Second, because the majority of the included primary studies do not allow for strong causal inferences, we suggest a fruitful avenue for research is to conduct field studies to experimentally examine the effect of training programs designed to increase coach autonomy supportive behavior on athlete functioning and wellness in sport and exercise settings. While a recent systematic review of the literature has been conducted (Raabe et al., 2019), this review shows that the sport and exercise literature is still too underdeveloped to meta-analyze and until more primary studies of this nature are completed, drawing strong causal inferences will be problematic.

A further limitation of the literature worth mentioning is the insufficient available studies to comprehensively examine the comparative consequences of coach motivating styles, such as controlling coach behaviors, or other coach behaviors that support basic needs (e.g. competence support, relatedness support). This prevented our ability to examine whether the effects of these behaviors are comparable in strength to those of autonomy support for similar correlates, or whether they are moderated by similar factors.

Limitations of the present study

Notwithstanding the strengths of meta-analysis (Schmidt & Hunter, 2015), our results should be interpreted considering some limitations. First, as we have noted, because our meta-analysis was based on studies that used correlational data, most of which was cross-sectional, we must exercise caution in inferring causal processes. Despite including lagged effects where possible, we could not rule out, for example, whether the experience of autonomous motivation or basic need satisfaction in athletes invokes a more autonomy supportive style in the coach. It would benefit future research to replicate these findings with designs that employ randomized controls or other non-experimental designs that allow for stronger causal inferences (Cartwright, 2010; Diener et al., in press). Second, for some variables within our analyses (Table 1), the number of available studies was small and may contain second-order sampling error (Schmidt & Hunter, 2015) and should warrant caution. Similarly, for some variables we were not able to examine certain moderators (e.g. the actual sport, competitive standard), and we did not have enough included samples to examine gender as a moderator, highlighting a gap in the literature for future research to consider. Additionally, we were not able to examine factors that may offer incremental benefit over and above coach autonomy support (peer-competence

or relatedness supports) due to insufficient primary studies reporting the requisite information. These factors therefore present an opportunity for future research. Still, the results of our primary main effect and hypothesis driven moderator analyses were sufficient to warrant valid conclusions. We also note that we make available our relevant project materials on our project website via the Open Science Framework (e.g. data sets, analytic scripts; see https://osf.io/a6e4u) so that readers can judge the reproducibility and transferability of our findings.

Conclusion

In sum, our meta-analysis demonstrated that coach autonomy support is an important predictor of favorable athlete outcomes in sport. Our meta-analysis confirmed positive associations with athlete basic need satisfaction, internalized motivation, well-being, positive athlete functioning, and negative associations with indicators of athlete distress and need frustration across cultures. Overall, our study provides support for the tenets of SDT and highlights that further research is needed to examine the relationship between autonomy support and other dimensions of the coach-created climate.

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No potential conflict of interest was reported by the author(s).

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Data availability statement

The data that support the findings of this study are openly available in the Open Science Framework at https://osf.io/a6e4u/

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