Current Issues in Sport Science 4 (2019)

Need-supportiveness and athlete well-being: Coaches' competence-support at risk in the elite sport context throughout the season*

Hedda Berntsen[1,*], Andreas Ivarsson[2] & Elsa Kristiansen[3]

1 Norwegian School of Sport Sciences, Norway

2 Center of research on Welfare, Health and Sport, Halmstad University, Sweden

3 School of Business, University of South-Eastern Norway, Drammen, Norway

* Corresponding author: Department of Coaching and Psychology, Norwegian School of Sport Sciences, Sognsveien 220, 0863 Oslo
Tel: +47 23262286
E-Mail: hedda.berntsen@nih.no

ORIGINAL ARTICLE

Article History:
Submitted 20th April 2019
Accepted 23th August 2019
Published 6th November 2019

Handling Editor:
Günter Amesberger & Sabine Würth,
University of Salzburg, Austria

Editor-in-Chief:
Martin Kopp
University of Innsbruck, Austria

Reviewers:
Reviewer 1: Heather Larson,
University of Alberta, Canada
Reviewer 2: Anonymous

ABSTRACT

The aim of this study was to explore how perceptions of coaches' behaviour affected athletes' well-being, by examining: (a) the potential change in perceptions of need-support from the coach (over an academic year), and (b) the within-person relationship between the three aspects of need-supportiveness and subjective vitality at the end of the winter sport season. Elite student athletes (N = 102, M age = 17.04) completed a questionnaire three times. Bayesian growth curve analyses showed that perceptions of relatedness and autonomy support were stable and high throughout the year. In contrast, perceptions of competence support decreased during the season. In addition, the results showed a credible positive within-person relationship between changes in all three facets of need-supportiveness from the coach and vitality measured at the end of the season, which supports SDT tenets. These findings reveal the importance of need-support for athletes' well-being, and show that competence support needs extra attention in the elite sport context where competence satisfaction is constantly challenged.

Keywords:
Athlete well-being – need-supportive coaching – elite sport school context – successful coaching

Citation:
Berntsen, H., Ivarsson, A. & Kristiansen, E. (2019). Need-supportiveness and athlete well-being: Coaches' competence-support at risk in the elite sport context throughout the season. Current Issues in Sport Science, 4:010. doi: 10.15203/CISS_2019.010.

Introduction

"Successful athletes with controlling coaches are proof that being controlling is a good motivational strategy" is a typical counter argument when discussing the importance of need-supportive coaching. Controlled motivation can indeed be a very powerful motivation, especially when self-worth is on the line (Ryan & Deci, 2017). In fact, *both* controlling social contexts and supportive social contexts can produce medal winners. At least for some, however, this "evidence that control works" fails to mention that this controlling, need thwarting style has its costs (Adie, Duda, & Ntoumanis, 2012; Balaguer et al., 2012; Cheval, Chalabaev, Quested, Courvoisier, & Sarrazin, 2017). By controlling, we mean an interpersonal style that actively thwarts athletes' needs, going beyond the mere absence of need-supportive behaviours (Bartholomew, Ntoumanis, Ryan, Bosch, &

* The data was collected before and after the implementation of the Motivation Activation Program in Sports (MAPS: Berntsen & Kristiansen, 2019).

Thogersen-Ntoumani, 2011). Furthermore, the need-supportive and controlling interpersonal styles are orthogonal, and coaches often use a combination of these two styles (Matosic et al., 2016). A need-supportive style is defined as autonomy-support acompanied by structure and interpersonal involvement (Mageau & Vallerand, 2003).

The critical difference between a controlling and supportive pathway to elite sports is the *well-being* of the athletes operating within the sport context. Research supports the often observed costs from controlling coaches such as general ill-being (Cheval et al., 2017), burn-out (Balaguer et al., 2012; Healy, Ntoumanis, van Zanten, & Paine, 2014), maladaptive coping (Bartholomewet al., 2011), and disaffection (Curran, Hill, Hall, & Jowett, 2014), whereas the autonomy-supportive coaching style is associated with athlete well-being (Adie et al., 2012; Balaguer et al., 2012; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Cheval et al., 2017; González, Tomás, Castillo, Duda, & Balaguer, 2017; Healy et al., 2014). In this study with aspiring young athletes, we conceptualize psychological well-being in terms of subjective vitality in our exploration of changes in need-supportiveness and its association with well-being over a competitive season at an elite sport school.

The context of the present study

The present study was executed at *The Norwegian College of Elite Sport* (hereafter NTG), a non-profit private foundation. Elite sport schools in Norway are important stakeholders for talent development (Kristiansen & Houlihan, 2017). NTG currently runs six schools with 990 students participating in 27 different sports (NTG, 2018). Current and former NTG athletes have achieved considerable success, accumulating around 600 national championship gold medals, 175 world championship medals, and 26 gold, 17 silver, and 21 bronze medals in the Olympics (between the 1992 and the 2018 winter Olympics) (NTG, 2018). The school has high ambitions for their student-athletes (Berntsen, Lemyre, & Røe, 2014), and both athletes and coaches may experience pressures over a season. Coaches may experience pressures from the school to live up to its elite status. Athletes may experience performance pressures from their parents' and coaches.

Self-Determination Theory

Self-determination theory **(**SDT) is based on the assumption that certain social conditions facilitate or hinder human flourishing (Deci & Ryan, 1985, 2000; Ryan & Deci, 2017). The satisfaction of three basic psychological needs, the needs for *autonomy, competence,* and *relatedness,* are essential to optimal functioning and growth, integrity, and well-being (Ryan & Deci, 2000). Autonomy refers to the perception that one's actions are reflectively self-endorsed. Competence is feeling that one interacts effectively and confidently with the environment. Relatedness is when one feels cared for and connected to others, and experiences a sense of belonging (Ryan & Deci, 2017).

Basic psychological needs theory (BPNT), the fourth of SDT's six mini theories, is based on the notion that satisfaction of the three needs is facilitated and predicted by autonomy-support (Ryan & Deci, 2017). For instance, for athletes to feel competent it is critical that their actions are perceived as self-organized or initiated—in other words, they feel ownership of the activities in which they succeed (Deci & Ryan, 1985). Autonomy is fundamental for competence. The psychological needs for relatedness and competence depend on the person's capacity and freedom to self-organize (Ryan & Deci, 2017). Hence, autonomy-support is a critical aspect of a need-supportive environment (Ryan & Deci, 2017), and also for young talents within a structured sport school context. Autonomy supportive behaviours have been shown to simultaneously support more than one psychological need. This has been referred to as the multiple-needs effect, and has been observed in correlational studies (Adie, Duda, & Ntoumanis, 2008; Adie et al., 2012; Amorose & Anderson-Butcher, 2007; Gagné, Ryan, & Bargmann, 2003; Hodge & Lonsdale, 2011; Pelletier, Fortier, Vallerand, & Briere, 2001), longitudinal correlational studies (Adie et al., 2012; Pelletier et al., 2001), and in intervention-based studies (Cheon, Reeve, Lee, & Lee, 2015; Cheon, Reeve, & Ntoumanis, 2018).

Despite the multiple need effect associated with autonomy-support, Tessier, Sarrazin, and Ntoumanis (2010) argue that interventions must feature an explicit focus on both competence support and relatedness support to use the terminology *need supportive*. It has been suggested that need-supportive behaviours include autonomy support that is accompanied by structure and interpersonal involvement (e.g., Mageau & Vallerand, 2003; Matosic, Ntoumanis, & Quested, 2016; Taylor & Ntoumanis, 2007). Structure was explained as the extent to which the coach allows her or his athletes to feel competent (Mageau & Vallerand, 2003). Coaches can, through their instructions and structure, and, based on their knowledge, be essential to athlete progress and perception of competence. Involvement was explained as the extent to which the coach allows athletes to connect with others (Mageau & Vallerand, 2003). Structure and involvement of the coach are important determinants of athletes' perceptions of competence and relatedness in addition to existing autonomy-supportive behaviours and their multiple needs-effects (Mageau & Vallerand, 2003; Matosic et al., 2016; Ntoumanis, 2012).

Coaching in the elite sport school context

Coaches with athletes competing in high-stake sport competitions tend to adopt maladaptive coaching styles (Cheon et al., 2015) as "elite contexts can often involve more pressure toward winning, which can readily translate into more controlling styles" (Ryan & Deci, 2017, p. 496). Rocchi and colleagues (2013) confirmed that coaches tend to act less autonomy-supportive towards their athletes when perceiving pressure from above (e.g., administrators) or from below (e.g., athlete disengagement). This is in concert with two (of three) of Mageau and Vallerand's (2003) determinants of coach behaviours as found in

their coach-athlete motivational model. First, coach context or pressure from above is the pressure the coach feels to perform, which can in turn lead them to pressure athletes to perform. Second, coaches' perceptions of athlete motivation and behaviour (pressure from below) can influence coach controlling behaviours towards athletes. Additionally, Mageau and Vallerand (2003) included coaches' personal orientation as a determinant of coach behaviour. Coaches' beliefs about what good coaching is will likely influence the ways in which they behave towards their athletes, consequently. The elite competitive contexts can pressure coaches toward a maladaptive controlling style, which can reduce their need-support and thus need-support is at risk in the elite context. Unfortunately, athletes and coaches operating in competitive contexts experience a great deal of pressure—the higher the stakes, the more pressure to win (Fortier, Vallerand, Brière, & Provencher, 1995; Reeve & Deci, 1996; Ryan & Deci, 2017).

In a study by Cheon et al. (2015) with the aim to test athletes' perceptions of their coaches' interpersonal-style, one intervention group of coaches received training in the autonomy-supportive style while the coaches in the control group did not. Afterwards, the athletes perceived the coaches from the intervention group as somewhat more autonomy-supportive, and they generally maintained measures of motivation, engagement, and functioning over eight weeks. In contrast, the athletes of the coaches from the control group were perceived as less autonomy-supportive, and athletes experienced deterioration in all measures. The intervention results led Cheon et al. (2015) to conclude that enacting an autonomy supportive coaching style functions as an antidote to a controlling coach style.

The need for competence in the sport school contexts

Rivalry and constant competition between athletes are a big part of the elite sport school context. Competitive settings can offer opportunity for skill development or mastery at drills and exercises and strengthen intrinsic motivation *or* foster controlling aspects such as comparing athletes to each other and undermining intrinsic motivation (Ryan & Deci, 2017). Research on intrinsic motivation has shown that when participants lose in competition their intrinsic motivation often suffers, largely through diminished feelings of competence (Ryan & Deci, 2017). Vansteenkiste and Deci (2003) found that when offering positive competence feedback to athletes who had lost, their intrinsic motivation was higher than athletes who lost but did not get this kind of feedback. In the same study, Vansteenkiste and Deci found that receiving a monetary reward following a win counteracted the positive aspect of winning because it was perceived as controlling. These findings are important for athletes in the elite school context, especially considering they often receive prizes in the form of trophies, money, or material goods (e.g., bags, clothes, goggles, skis, snowboards). On top of these tangible rewards, athletes are subject to performance-contingent rewards (e.g., ranking; Ryan & Deci, 2017). Indeed, reward systems are a big part of athletes' lives (Treasure, Lemyre, Kuczka, & Standage, 2007).

SDT suggests that need-supportive coaching is equally important at all levels of sports (Ryan & Deci, 2017). At the top level of youth elite sport, there is an intense competition schedule, and we expect athletes' competence satisfaction to suffer, even when coaches offer positive competence feedback.

Based on the theoretical framework discussed above, we hypothesized that elite competitive contexts can pressure coaches toward a maladaptive controlling style and that need-support is at risk in the elite context. However, there is scant literature in sport and exercise psychology on *change* in psychological variables such as motivation and stress (Stenling, Ivarsson, & Lindwall, 2017). Aditionally, there is limited longitudinal research on assessment of, and change in the three constructs of the need-supportive style in an elite sport school context. This leaves us with a limited understanding of need-supportive behaviour in the elite context, and how it affects athletes' well-being.

The present research

The aforementioned concepts of need-supportiveness (predictor) and well-being (outcome) can be located on either side of the complete SDT causal sequence (Fortier, Duda, Guerin, & Teixeira, 2012; Grouzet, Vallerand, Thill, & Provencher, 2004; Vallerand, 1997; Vallerand, Fortier, & Guay, 1997; Vallerand & Losier, 1999). A fair number of studies have tested the basic psychological needs theory (Deci & Ryan, 2000) and examined the relationships between coach interpersonal style, need-satisfaction, and athlete well-being longitudinally (Balaguer et al., 2012; Cheval et al., 2017; González et al., 2017). The focus of these investigations has mainly been on the mediating effect of need-satisfaction. The lack of longitudinal studies investigating need-support and the three aspects of it may be due to the lack of scales that can evaluate all aspects of need-supportive coaching (see 2.5).

The aim of this study was to explore how perceptions of coaches' behaviour affected athletes' well-being, by examining: (a) the potential change in perceptions of need-support from the coach (over an academic year), and (b) the within-person relationship between the three aspects of need-supportiveness and subjective vitality at the end of the winter sport season. We hypothesized that coaches in elite sport schools may become less supportive towards their athletes throughout the season due to pressure from above and below, resulting in decreased athlete perceptions of support. Furthermore, it was hypothesized that athletes might need even more competence support throughout the season because of the pressure they face in training and races throughout the year. It was anticipated that a coach's interpersonal style that is perceived to support autonomy, competence, and relatedness will enhance athlete vitality (Ryan & Deci, 2008; Ryan & Deci, 2017).

Method

Participants

The 102 winter sport student athletes (male=70, female=32, age 16-18, *M* age= 17.04, *SD*= 0.87) at NTG answered validated questionnaires to assess their perceptions of their coaches' need-support and their own well-being at three times points over a year (beginning, middle, end). Athletes represented five winter sports: Freeskiing (n=5), Snowboarding (n=12), Alpine Skiing (n=17), Cross-Country (n=31) and Biathlon (n=34). The 10 coaches were 25-54 years of age (male=9, female=1, *M* age=36.4, *SD*= 9.167). Their NTG working experiences ranged from no prior full-time coach experience to true veterans with over 10-years of experience at NTG (*M* = 5.4, *SD* =4.35).

Procedure and Design

We obtained informed consent from all athletes and parents, and the investigation was conducted in accordance with ethical research guidelines. The facilitator administered the questionnaires to the athletes in their classroom, which created consistency for the athletes. Temporal precedence is an issue relevant for internal validity. The study had a longitudinal design and therefore was influenced by time. At each measurement time, the athletes were asked to report on coaches' typical behaviour in coach led training-sessions over the last few weeks (so that we could assess the change), and the last seven days for subjective vitality. Thus, both assessments were at the state level.

The measurement package

The main focus of our investigation was the change in perceptions of need-supportiveness, and the unique impact of perceptions of coaches' need-support on athletes' subjective vitality. Hence, we measured the predictor (perceptions of coaches' need-support) and the outcome (subjective vitality) of the full SDT- process sequence, neither incorporating need-satisfaction nor sport motivation in our analysis. However, one limitation of research into athletes' perceptions of coaches' interpersonal styles has been the lack of a valid measure, and unfortunately, the *Interpersonal Behaviors Questionnaire (IBQ) in sport* was published after our study's start (Rocchi et al., 2017). Previous researchers have used different scales to assess coaches' interpersonal style by assessing mastery, social support (relatedness), and autonomy-support separately (Reinboth, Duda, & Ntoumanis, 2004), or only used autonomy-support to assess coaches' interpersonal style (Balaguer et al., 2012; Cheval et al., 2017; González et al., 2017).

In the absence of one validated scale to assess coach autonomy-support, competence-support, and relatedness-support, we translated the *Questionnaire of Basic Psychological Needs Support* from English to Norwegian. The first author started out translating the scale from English, as well as making the adaptions to the questionnaires from the Physical Education to the sport context. In this process, the first author made sure that it was a proper content replacement. Next, an English language expert proof-read the translation. Finally, a professor with extensive knowledge on motivation and the context of youth sport, who is fluent in both languages, worked through the translations sending a final version back to the first author. The questionnaires were prepared to assess the measures at the state level, as we were interested in the athletes' perceptions of subjective vitality and perceptions of coach behaviour in the elite sport domain over the last week.

Questionnaire of Basic Psychological Needs Support (QBPNS)

Athletes' perceptions of their coaches' interpersonal need-supportiveness were assessed by the Norwegian version of the *Questionnaire of Basic Psychological Needs Support (QB-PNS)* (Sánchez-Oliva, Garcia-Calvo, Sánchez-Miguel, Amado, & Ntoumanis, 2013). The 7-point Likert scale consists of 12 items (1=completely disagree, 4=somewhat agree, 7=completely agree). Athletes were asked to answer 12 different statements following "During practice, my coach...." (e.g., encourages our ability to carry out the task well). In contrast to other scales assessing coach interpersonal styles, the QBPNS takes into consideration all three needs and evaluates athletes' perception of their coach's behaviour in terms of supporting the need for autonomy, competence, and relatedness. This was important for the current investigation, in addition to using a scale to provide insight into situationally induced and changing coach behaviour and the following fluctuations. We assessed perceived need-support "over the last few weeks."

Subjective vitality

Athletes' well-being was assessed using the subjective vitality scale (Ryan & Frederick, 1987) with a 7-point Likert scale consisting of seven items (1=not at all true 7=very true). Athletes were asked to what degree the different statements were true for the last seven days (state level) e.g., "I feel alive and vital." In SDT, the definition of well-being goes beyond hedonic outcomes such as happiness and is conceptualized in terms of full functioning (Deci & Ryan, 2017). The rationale behind choosing subjective vitality as an indicator of athlete well-being (wellness) is that vitality is a state of being fully functioning or thriving by SDT (Ryan & Deci, 2017; Ryan & Huta, 2009). Vitality is theorised to be the most general characteristic of a fully functioning person as it reflects organismic wellness (Ryan & Deci, 2017). Vitality is defined as "one's conscious experience of possessing energy and aliveness" (Ryan & Frederick, 1997, p. 530). Vitality pertains to a sense of having energy available to the self that can be used in volitional ways--not just being in a state of arousal. The extent to which athletes experience their energy as *their own* corresponds with their sense of vitality (Ryan & Frederick, 1997).

Data analyses

All analyses were estimated with use of a Bayesian approach. One of the main differences between the Bayesian statistical approach and the more traditional frequentist approach is that it is based on different statistical assumptions (for more information see, for example, Stenling, Ivarsson, Johnson, & Lindwall, 2015). In comparison to the frequentist approach, the Bayesian approach has a better likelihood of producing reliable estimates with small sample sizes (Song & Lee, 2012). In fact, research has shown that multilevel models with sample sizes of just 20 participants can generate accurate estimates (Hox, van de Schoot, & Matthijsse, 2012). Furthermore, due to the less restrictive distributional assumptions, the normality assumption does not need to be fulfilled to perform the analyses within the Bayesian approach (Yuan & MacKinnon, 2009).

We calculated descriptive statistics using JASP software package (Love et al., 2015). We applied Bayesian correlation analyses to investigate the relationships between the study variables. For each of the pair-wise comparisons, a Bayes Factor (BF) was calculated. In line with previous recommendations, a BF above 10 was determined to be in strong support of the alternative hypothesis (i.e., there is a statistical relationship between the two variables; Etz & Vandekerckhove, 2016).

There was a total of 15% missing data (186 data points out of 1224). Bayesian independent t-test was performed to test whether there was systematic missingness in the any of the variables between the participants with full data and the participants missing one or two measurement waves. Data was considered as missing at random because there was strong support for the null hypotheses (BF ranged from 0.37 to 1.63). In the Bayesian Structural Equation Modeling (BSEM) approach, the Gibbs sampler is used to handle missing data points. More specifically, the Gibbs sampler treats the missing observations as unknown and these will therefore be estimated (Stenling et al., 2015).

To test the potential change in perceptions of all three basic need support (i.e., autonomy, competence, and relatedness) variables over the three measurement waves, we estimated unconditional latent growth curve (LGC) models in Mplus 8.0 (L. Muthén & Muthén, 2017) using the Bayesian estimator. In the unconditional model, only the growth curve was estimated (without any other variables than the basic psychological need measured at T1, T2 and T3). For more information about the LGC analyses see, for example, Stenling et al. (2016).

To test whether changes in each of the basic psychological need support variable were associated with the level of subjective vitality at the end of the season (T3), three conditional LGC analyses were performed, one for each of the basic need support variables. In the conditional models, vitality was included as an additional variable, together with the three waves of basic psychological needs. In all three models, subjective vitality was regressed on both the intercept (i.e., initial level of basic need support at T1) and slope (i.e., change trajectory of the basic need support over the three measurement waves) parameter. To control for the potential influence of subjective vitality, measured at T1, on subjective vitality, measured at T3, an autoregressive effect was specified between these variables. Also, a correlation between subjective vitality and the basic need support, both measured at T1, was specified.

We used the Markov Chain Monte Carlo simulation procedures with a Gibbs sampler and performed 200,000 iterations for each analysis. In line with previous recommendations, a potential scale reduction factor around 1 was considered evidence of convergence (Kaplan & Depaoli, 2012). We assessed model fit using the posterior predictive *p* (PP*p*) value and its accompanying 95% confidence interval. In Mplus "the 95% confidence interval is produced for the difference in the *f* statistic for the real and replicated data. A positive lower limit is in line with a low posterior predictive *p* value and indicates poor fit" (Muthén & Asparouhov, 2012, p. 315). Default priors were used for all models.

We estimated credibility interval (CI) for all parameters estimated within the models. In comparison to the more traditional confidence interval, the credibility interval indicates the probability (e.g., 95%) that the parameter of interest, given the observed data, lies between the two values. The recommendations from Zyphur and Oswald (2015) were followed, meaning that we rejected the null hypothesis if the 95% CI did not include zero.

Mean and variance priors for the change in basic psychological need support and structural parameter estimates (i.e., the path between change in basic psychological need support and subjective vitality measured at T3 were used in the analyses). The prior probability of a parameter, which can be included into the model, reflects the researcher's knowledge about the parameter before the data is observed. The prior information can, for example, be collected from previous research (Zyphur & Oswald, 2015). The prior for change in psychological need support, specified in both the unconditional and conditional models, was obtained from Cheon et al. (2015). The prior for the relationship between change in psychological need support and subjective vitality, measured at T3, came from Stenling, Lindwall, and Hassmén (2014).

Sensitivity analyses were performed for each estimated model to investigate whether changes in the prior variances (i.e., .001, .01, and .10) influenced the results. To compare these three models the deviance information criterion (DIC) was used. More specifically, a lower value indicated a better-fitting model (Asparouhov, Muthén, & Morin, 2015). The prior setting that showed best fit to data for the unconditional latent growth curve models was also applied for the change parameter in the conditional latent growth curve models.

Results

Descriptive statistics

Table 1 shows the means, standard deviations, ranges, skewness value, and reliability for all variables. In general, relatively high levels of internal consistency (Cronbach's alpha) were found. Participants reported high levels of relatedness support, competence support, autonomy support, and subjective vitality. The descriptive statistics suggest that, overall, athletes perceived their coaches to support their basic psychological needs and they experienced high levels of subjective vitality. For descriptive statistics, see Table 1.

Table 1: Descriptive statistics and correlations.

Variable	M (SD)	1	2	3	4	5	6	7	8	9	10	11	12
1. Aut T1	5.44 (0.75)												
2. Aut T2	5.52 (0.89)	0.02											
3. Aut T3	5.33 (1.17)	0.01	0.63*										
4. Comp T1	6.42 (0.55)	0.42*	0.21	0.13									
5. Comp T2	6.21 (0.74)	-0.05	0.73*	0.47*	0.32*								
6. Comp T3	5.98 (0.86)	-0.09	0.61*	0.76*	0.29	0.59*							
7. Rel T1	6.31 (0.66)	0.52*	0.18	0.07	0.66*	0.27	0.17						
8. Rel T2	6.30 (0.72)	0.03	0.59*	0.38*	0.35*	0.82*	0.58*	0.47*					
9. Rel T3	6.15 (0.77)	0.02	0.56*	0.56*	0.28	0.64*	0.73*	0.26	0.63*				
10. Vit T1	5.25 (0.84)	0.13	0.43*	0.33*	0.34*	0.47*	0.36*	0.31	0.42*	0.31			
11. Vit T2	5.19 (0.96)	-0.01	0.50*	0.53*	0.19	0.47*	0.50*	0.22	0.38*	0.39*	0.48*		
12. Vit T3	4.97 (1.10)	0.13	0.24	0.29	0.12	0.22	0.36*	0.11	0.19	0.29	0.41*	0.53*	

Note: Aut = Perceived Autonomy Support; Comp = Perceived Competence Support; Rel = Perceived Relatedness Support; Vit = Subjective Vitality; T1 = Measured at time 1; T2 = Measured at time 2; T3 = Measured at time 3. * BF > 10

Unconditional latent growth curves

The results from the unconditional latent growth curves are presented below.

Autonomy

The sensitivity analyses showed that the model with a weak variance prior (i.e., .1) showed, in comparison to the two other models, best fit to data (for DIC values see Table 2). The model showed good fit to data (PP*p* = .46, 95% Confidence Interval = [-11.93, 11.77]). The model had a credible intercept (5.46, 95% CI = [5.31, 5.61], but there was no credible change over time (Δ = -.05, 95% CI = [-.18, .09]. The variances for both the intercept (Ψ = .09, 95% CI = [.01, .30] and the growth trajectory (Ψ = .32, 95% CI = [.17, 51] were both credible.

Competence

The sensitivity analyses showed that the model with a weak variance prior (i.e., .1) showed, in comparison to the two other models, best fit to data (for DIC values see Table 2). The model showed good fit to data (PP*p* = .60, 95% Confidence Interval = [-13.43, 12.53]). The model had a credible intercept (6.40, 95% CI = [6.28, 6.51], and a credible decline over time (Δ = -.20, 95% CI = [-.30, -.10]. The variances for both the intercept (Ψ = .15, 95% CI = [.04, .31] and the growth trajectory (Ψ = .13, 95% CI = [.06, 22] were both credible.

Relatedness

The sensitivity analyses showed that the model with a weak variance prior (i.e., .1) showed, in comparison to the two other

Table 2: Comparison of parameter estimates of using different priors in the unconditional models.

	Prior Mean	Model A	Model B	Model C
Autonomy Support				
Intercept	NA	5.43 [5.28, 5.63]	5.37 [5.23, 5.49]	5.46 [5.31, 5.61]
Change	.16	0.02 [-0.10, 0.14]	0.13 [0.07, 0.19]	-0.05 [-0.18, 0.09]
Variance Intercept	NA	0.10 [0.01, 0.31]	0.10 [0.01, 0.33]	0.09 [0.01, 0.31]
Variance Change	NA	0.32 [0.17, 0.52]	0.35 [0.18, 0.55]	0.32 [0.17, 0.51]
PPp (95% CI)		0.41 [-11.63, 15.11]	0.17 [-7.33, 19.80}	0.46 [-11.03, 11.77]
DIC		678	682	677
Competence Support				
Intercept	NA	6.37 [6.25, 6.48]	6.27 [6.14, 6.40]	6.40 [6.28, 6.51]
Change	0.16	-0.14 [-0.22, -0.05]	0.07 [0.01, 0.13]	-0.20 [-0.30, -0.10]
Variance Intercept	NA	0.15 [0.04, 0.31]	0.16 [0.03, 0.33]	0.15 [0.04, 0.31]
Variance Change	NA	0.13 [0.06, 0.23]	0.20 [0.10, 0.33]	0.13 [0.06, 0.22]
PPp (95% CI)		0.46 [-11.75, 14.72]	0.00	0.60 [-13.43, 12.53]
DIC	NA	536	563	534
Relatedness Support				
Intercept	NA	6.29 [6.15, 6.43]	6.19 [6.05, 6.32]	6.33 [6.18, 6.47]
Change	0.16	-0.04 [-0.12, 0.05]	0.09 [0.04, 0.15]	-0.07 [-0.17, 0.02]
Variance Intercept	NA	0.32 [0.16, 0.53]	0.35 [0.18, 0.57]	0.31 [0.16, 0.52]
Variance Change	NA	0.14 [0.05, 0.23]	0.17 [0.08, 0.27]	0.13 [0.05, 0.23]
PPp (95% CI)	NA	0.42 [-9.75, 14.14]	0.05 [-1.40, 27.18]	0.44 [-10.44, 12.52]
DIC	NA	524	536	524

Note: Model A = Moderate precise priors were set for the expected change estimates variances (i.e., .01); Model B = Highly precise priors were set for the expected change estimates variances (i.e., .01); Model C = Low precise priors were set for the expected parameter estimates variances (i.e., .10); NA = Not available.

Table 3: Comparison of parameter estimates of using different priors in the conditional models.

	Prior Mean	Model A	Model B	Model C
Autonomy Support				
Intercept	NA	5.47 [5.32, 5.62]	5.47 [5.32, 5.62]	5.47 [5.32, 5.61]
Change	.16	-0.05 [-0.19, 0.09]	-0.05 [-0.19, 0.09]	-0.05 [-0.19, 0.09]
Variance Intercept	NA	0.09 [0.02, 0.28]	0.10 [0.02, 0.28]	0.09 [0.02, 0.27]
Variance Change	NA	0.31 [0.19, 0.49]	0.31 [0.19, 0.49]	0.31 [0.18, 0.49]
T3 Vit ON Change	0.39	0.19 [.10, .29]	0.19 [0.13, 0.25]	0.19 [-0.05, 0.42]
T3 Vit ON Intercept	NA	-0.34 [-1.36, 0.52]	-0.33 [-1.37, 0.53]	-0.38 [-1.43, 0.63]
T3 Vit ON T1 Vit	NA	0.53 [-0.05, 1.53]	0.52 [-0.07, 1.52]	0.55 [-0.13, 1.60]
T1 Vit WITH Intercept	NA	0.58 [0.03, 0.96]	0.57 [0.03, 0.96]	0.58 [0.04, 0.96]
PPp (95% CI)		0.41 [-.16.79, 20.44]	0.40 [-17.24, 20.38]	0.46 [-16.84, 20.68]
DIC		1103	1103	1104
Competence Support				
Intercept	NA	6.40 [6.28, 6.52]	6.40 [6.28, 6.52]	6.40 [6.28, 6.52]
Change	0.16	-0.20 [-0.30, -0.10]	-0.20 [-0.30, -0.10]	-0.20 [-0.30, -0.10]
Variance Intercept	NA	0.12 [0.04, 0.27]	0.12 [0.04, 0.27]	0.12 [0.04, 0.27]
Variance Change	NA	0.13 [0.06, 0.23]	0.13 [0.06, 0.23]	0.13 [0.06, 0.22]
T3 Vit ON Change	0.39	0.13 [0.06, 0.21]	0.12 [0.08, 0.17]	0.17 [0.01, 0.35]
T3 Vit ON Intercept	NA	0.02 [-0.04, 0.76]	0.02 [-0.93, 0.77[	0.00 [-0.99, 0.75]
T3 Vit ON T1 Vit	NA	0.39 [-0.28, 1.22]	0.39 [-0.29, 1.19]	0.40 [-0.25, 1.24]
T1 Vit WITH Intercept	NA	0.66 [0.31, 0.96]	0.66 [0.31, 0.96]	0.66 [0.30, 0.96]
PPp (95% CI)		0.42 [-15.62, 19.47]	0.43 [-15.87, 19.60]	0.44 [-16.75, 19.39]
DIC		955	955	955
Relatedness Support				
Intercept	NA	6.33 [6.19, 6.47]	6.33 [6.19, 6.47]	6.33 [6.19, 6.47]
Change	0.16	-0.08 [-0.18, 0.02]	-0.08 [-0.18, 0.02]	-0.08 [-0.18, 0.02]
Variance Intercept	NA	0.30 [0.13, 0.50]	0.30 [0.13, 0.51]	0.29 [0.13, 0.50]
Variance Change	NA	0.14 [0.05, 0.23]	0.14 [0.05, 0.23]	0.13 [0.05, 0.23]
T3 Vit ON Change	0.39	0.13 [.06, .22]	0.13 [.08, .18]	v.16 [.00, .33]
T3 Vit ON Intercept	NA	0.04 [-.28, .35]	0.04 [-.28, .34]	.04 [-.28, .35]
T3 Vit ON T1 Vit	NA	.40 [.12, .63]	.40 [.12, .63]	.39 [.12, 63]
T1 Vit WITH Intercept	NA	.44 [.17, .72]	.44 [.17, .72]	.44 [.17, .72]
PPp (95% CI)		0.44 [-17.91, 21.67]	0.45 [-.17,89, 21.68]	0.45 [-17.94, 21.48]
DIC	NA	954	954	954

Note: Model A = Moderate precise priors were set for the variance related to the path between change in basic psychological need support and vitality measured at T3 (i.e., .01); Model B = Highly precise priors set for the variance related to the path between change in basic psychological need support and vitality measured at T3 (i.e., .001); Model C = Low precise priors set for the variance related to the path between change in basic psychological need support and vitality measured at T3 (i.e., .10); NA = Not available.

models, best fit to data (for DIC values see Table 3). The model showed good fit to data (PP*p* = .44, 95% Confidence Interval = [-10.44, 12.52]). The model had a credible intercept (6.33, 95% CI = [6.18, 6.47], but no credible change over time (Δ = -.08, 95% CI = [-.17, .02]. The variances for both the intercept (Ψ = .31, 95% CI = [.16, .52] and the growth trajectory (Ψ = .14, 95% CI = [.05, 23] were credible.

Conditional latent growth curve models

In the second step of the three separate models, each of the basic need support subscales were estimated to investigate the relationship between change in basic need support and subjective vitality measured in the end of the season (T3). The sensitivity analyses showed that all three models, for all the three basic need support variables, indicated good model fit. All models for each of the basic need support variables also showed similar DIC values for the three models. In addition, the parameter estimates for the intercept and change parameters as well as the regression paths were in the same direction. Because the models with the high informative prior for the variance on the change parameter (i.e., 0.001) had the lowest uncertainty (showed by the narrow CI) for all three basic need support variables, we chose to focus on these models in the discussion of the results (for all model fit indices, see Table 3).
As shown in the unconditional latent growth models, only perceptions of competence support had, in the conditional models, a credible, negative change during the season. For autonomy support and relatedness support no credible change was found. For the perceptions of the three basic psychological needs support variables there were credible positive relationships between change and vitality measured at T3 (for specific parameter estimates see Table 3). More specifically, increases in perceptions of all basic psychological needs support constructs were related to higher levels of vitality measured in the end of the season. For all parameter estimates specified in the model see Table 3.

Discussion

The purpose of this study was to investigate change in elite young athletes' perceptions of the three aspects of need-supportiveness, and the within-person relationship between change in perceived need-supportiveness and subjective vitality at the end of the year academic year.

Coaches became less competence-supportive throughout the year

The first objective of the current study was to examine whether athletes perceived a change in need-supportiveness throughout an academic year from their respective coaches. Unique for this study was that the need-supportive constructs of autonomy-support, competence-support, and relatedness-support were analysed separately. The athletes reported to perceive the same level of autonomy-support and relatedness-support from their coach throughout the three measurement points. This was unexpected considering that previous research and SDT theory indicate that competitive contexts typically pressure coaches to act less supportive (Cheon et al., 2015; Ryan & Deci, 2017). However, results revealed that, although the coaches were still perceived as competence supportive at the end of the season, athletes perceived a decrease in their coaches' *competence-support* throughout the season. The competence need is salient in the elite sport school context with its direct competition, tangible feedback, and obligations and grading from the school that is part of the elite sport context. The findings support previous findings of the importance of competence feedback to ameliorate the negative effect of pressure (Cheon et al., 2015; Fortier et al., 1995; Reeve & Deci, 1996).
As competence satisfaction is crucial for athletes' motivation, it is critical that coaches focus on, and practice competence supportive skills throughout the season. Berntsen and Kristiansen (2019) developed a set of explicit coaching skills to accompany Mageau and Vallerand's (2003) seven autonomy-supportive strategies, incorporating an explicit focus on support for competence and relatedness. These provide a helpful starting point for coaches looking to support their athletes' competence satisfaction (See Table 4; Berntsen & Kristiansen, 2019). The first competence supportive strategy is providing non-controlling competence feedback (Mageau & Vallerand, 2003). Berntsen and Kristiansen (2019) suggest coaches start by providing *factual, non-judgemental feedback about problems*. This first skill is vital in the feedback process, because this skill can provide athletes with information that can enhance their competence quickly. For an alpine coach who has an athlete that constantly gets late pressure – the feedback could be that: "because your line is too tight, an early pressure is not possible – you would end up inside the gate. Thus could next be followed by an explanation with exact instructions of what to improve, e.g., give more room at top of the turn to be able to have an early pressure. This enables the athlete with information about how to improve. The next recommendation to keep the feedback competence supportive is to *provide positive feedback that conveys high, but realistic expectations* (Berntsen and Kristiansen, 2019). To continue the example from above, the coach could use video to show the athlete the optimal line. The coach offers positive feedback and will expect the athlete to ski the optimal line, as they have seen the athlete ski this line in practice. Coaches are encouraged to engage in a continuous dialogue about what technical, tactical, or mental skills to work on with each individual athlete, and give positive feedback when the athletes master the drills and exercises during training. The third recommendation is to *target behaviours that are within the athletes' control – optimal challenge.* By offering raise-line gates at different distances in training, for example, the athlete can improve her or his skill, in this case to have enough room at top of the turn, and improve.

Table 4: Competence supportive strategies accompanied by explicit skills (Berntsen & Kristiansen, 2019).

Provide non-controlling competence feedback
1. Give actual, non-judgmental feedback about problems
2. Give positive feedback that convey high but realistic expectations
3. Target behaviours that are under the athletes control – optimal challenge
Prevent ego-involvement in athletes
1. Focus on self-improvement
2. Focus on mastery and effort in the group
3. Use self-set goals
4. Give attention to all athletes, regardless if they are doing well or struggle

The second competence supportive skill is to prevent ego-involvement in athletes by first *focusing on self-improvement* (See Table 4). Coaches play an important role in athletes maintaining their developmental focus throughout the season. For instance, a coach can easily be influenced by the athlete's results in the type of feedback they offer. If the given feedback is based on poor results, the focus might move from athletes' focus areas to comparing their performance with their better and more successful teammates or competitors. This can be avoided if coaches instead focus on each individual athlete's improvement in training and racing. The next recommendation for the coaches is to *keep focusing on mastery and effort in the group*. By working collectively to learn new skills and try their best (effort), the team environment and conversation stay focused on skill development rather than attending only to the athletes that are the best. *Self-set goals* is another strategy that help athletes focus on and notice their development throughout the season. This means that they have technical, mental, and tactical areas to work on. The last suggestion for coaches is *to attend to all athletes, whether they are doing well or are struggling*.
The major inference from the present study is the critical role of competence-support in the elite sport context. Although all three needs are an integral part of the need-supportive interpersonal style, we argue that an extended focus on competence support in an elite context ameliorates the negative effects of pressure to perform and win that is prevalent in the elite sport context.

Need support and subjective vitality

The second aim of the current study was to examine the relationship between changes in the three need-supportiveness constructs and vitality at the end of the academic year among young elite sport school students. We aimed to identify which of the three dimensions of perceived need-support has important implications for athletes' well-being. Results showed a credible positive within-person relationship between changes in perceptions of all three need-supportiveness constructs from the coach and vitality measured at the end of the season. These observations support the underlying assumption of the SDT-sequence that all three facets of need-supportive behaviours are salient predictors of well-being (Balaguer et al., 2012; Ryan & Deci, 2017).

Strengths and limitations

This study uniquely contributes to the literature in three ways. First, the sample used is unique as the athletes came from Norway's most successful elite winter sport school. Second, we assessed perceptions of all three basic psychological needs longitudinally as we followed the population over a year and had three waves of data. Third, including subjective vitality in the analysis is unique and this added a better understanding of the change of, and association between perceived need-support and subjective vitality.
The small sample size (a result of this school's population being small) and the use of self-reported measures are limitations. Finally, when only investigating athletes' perceptions of coaches' need-supportive behaviours, we cannot be sure if coaches behaviours stayed fairly stable or if this was simply due to athletes' perceptions.

Future directions

This study revealed that athletes perceived their coaches' competence-support to decrease throughout the season, but little is currently known about the longitudinal change in coaches' actual need-supportive behaviours over a season in elite contexts. More research is needed to understand how the elite context influences coaches' competence supportive behaviours as well as athletes' perceptions of the given support and competitiveness in the social environment. A better understanding of coach behaviour is of great importance so researchers can use relevant research to design coach development programs.

Conclusion

This longitudinal study examined change in athletes' perceptions of all three constructs of a need-supportive interpersonal

style (e.g., autonomy-support, competence-support, and relatedness-support) in an elite sport school context. Competence support was the one need-supportive aspect that athletes perceived to be decreasing throughout the season. This is important information when designing coach training programs. We recommend an extra focus on the competence supportive strategies in elite contexts to counteract negative effects of losing, failing, or being under pressure (Ryan & Deci, 2008). Further, the investigation revealed the importance of all three facets of the need-supportive interpersonal style for athletes' well-being. How to optimize the athletes' social environments is vital not only for coaches and other professionals dealing with young elite athletes, but also for sport schools and national sporting organizations.

Acknowledgements

This research was supported by *The Norwegian Olympic and Paralympic Committee and Confederation of Sports* (NIF), *The Norwegian Ski Federation* (NSF) and *The Norwegian Research Centre for Children and Youth Sports* (FOBU) at The Norwegian School of Sport Sciences. Thanks to coaches and athletes at the Norwegian College pf Elite Sport for their participation in this research project. Thanks to Professor Geoffrey C. Williams MD (Phd Professor of Medicine at the Centre for Community Health and Prevention, University of Rochester, Rochester New York) for discussing the idea of this paper with the first author, and reading through the manuscript.

Funding

The authors have no funding or support to report.

Competing Interests

The authors have declared that no competing interests exist.

Data Availability Statement

All relevant data are within the paper.

Declaration of Interest Statement

The co-authors and I have no interests that might be interpreted as influencing the research process or results, and APA ethical standards were followed in the conduct of the study. We have no conflicts of interest to disclose.

References

Adie, J. W., Duda, J. L., & Ntoumanis, N. (2008). Autonomy support, basic need satisfaction and the optimal functioning of adult male and female sport participants: A test of basic needs theory. *Motivation and Emotion, 32*(3), 189-199.

Adie, J. W., Duda, J. L., & Ntoumanis, N. (2012). Perceived coach-autonomy support, basic need satisfaction and the well-and ill-being of elite youth soccer players: A longitudinal investigation. *Psychology of Sport and Exercise, 13*(1), 51-59.

Amorose, A. J., & Anderson-Butcher, D. (2007). Autonomy-supportive coaching and self-determined motivation in high school and college athletes: A test of self-determination theory. *Psychology of Sport and Exercise, 8*(5), 654-670.

Asparouhov, T., Muthén, B., & Morin, A. J. S. (2015). Bayesian structural equation modeling with cross-loadings and residual covariances: Comments on Stromeyer et al. *Journal of Management, 41*(6), 1561-1577.

Balaguer, I., González, L., Fabra, P., Castillo, I., Mercé, J., & Duda, J. L. (2012). Coaches' interpersonal style, basic psychological needs and the well-and ill-being of young soccer players: A longitudinal analysis. *Journal of Sports Sciences, 30*(15), 1619-1629.

Bartholomew, K. J., Ntoumanis, N., Ryan, R., & Thøgersen-Ntoumani, C. (2011). Psychological need thwarting in the sport context: Development and initial validation of a psychometric scale. *Journal of Sport and Exercise Psychology, 33*(1), 75-102.

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thogersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin, 37*(11), 1459-1473.

Berntsen, H. & Kristiansen, E. (2019). Guidelines for Need-Supportive Coach Development: The Motivation Activation Program in Sports (MAPS). *International Sport Coaching Journal, 6, 88-97.*

Berntsen, H., Lemyre, P.-N., & Røe, L. (2014). Fra klubb til verdenstopp [From sport clubs to elite sports]. Oslo: Norwegian School of Sport Sciences.

Cheon, S. H., Reeve, J., Lee, J., & Lee, Y. (2015). Giving and receiving autonomy support in a high-stakes sport context: A field-based experiment during the 2012 London Paralympic Games. *Psychology of Sport and Exercise, 19*, 59-69.

Cheon, S. H., Reeve, J., & Ntoumanis, N. (2018). A needs-supportive intervention to help PE teachers enhance students' prosocial behavior and diminish antisocial behavior. *Psychology of Sport and Exercise, 35*, 74-88.

Cheval, B., Chalabaev, A., Quested, E., Courvoisier, D. S., & Sarrazin, P. (2017). How perceived autonomy support and controlling coach behaviors are related to well-and ill-being in elite soccer players: A within-person changes and between-person differences analysis. *Psychology of Sport and Exercise, 28*, 68-77.

Curran, T., Hill, A. P., Hall, H. K., & Jowett, G. E. (2014). Perceived coach behaviors and athletes' engagement and disaffection in youth sport: The mediating role of the psychological needs. *International Journal of Sport Psychology, 45*(6), 559-580.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227-268.

Dreyfus, H. L., & Dreyfus, S. E. (1986). *Mind over machine. The Power of Human Intuition and Expertise in the Era of the Computer*. New York: The free press.

Etz, A., & Vandekerckhove, J. (2016). A Bayesian perspective on the reproducibility project: Psychology. *PloS one, 11*(2), e0149794.

Fortier, M. S., Vallerand, R. J., Brière, N. M., & Provencher, P. J. (1995). Competitive and recreational sport structures and gender: A test of their relationship with sport motivation. *International Journal of Sport Psychology, 26*(1), 24-39.

Gagné, M., Ryan, R. M., & Bargmann, K. (2003). Autonomy support and need satisfaction in the motivation and well-being of gymnasts. *Journal of Applied Sport Psychology, 15*(4), 372-390.

García-Calvo, T., Sánchez-Oliva, D., Leo, F. M., Amado, D., & Pulido, J. J. (2016). Effects of an intervention programme with teachers on the development of positive behaviours in Spanish physical education classes. *Physical Education and Sport Pedagogy, 21*(6), 572-588.

González, L., Tomás, I., Castillo, I., Duda, J., & Balaguer, I. (2017). A test of basic psychological needs theory in young soccer players: time-lagged design at the individual and team levels. *Scandinavian Journal of Medicine & Science in Sports, 27*(11), 1511-1522.

Gustafsson, H., Hassmén, P., & Podlog, L. (2010). Exploring the relationship between hope and burnout in competitive sport. *Journal of Sports Sciences, 28*(14), 1495-1504.

Healy, L. C., Ntoumanis, N., van Zanten, J. J. V., & Paine, N. (2014). Goal striving and well-being in sport: the role of contextual and personal motivation. *Journal of Sport and Exercise Psychology, 36*(5), 446-459.

Hodge, K., & Lonsdale, C. (2011). Prosocial and antisocial behavior in sport: The role of coaching style, autonomous vs. controlled motivation, and moral disengagement. *Journal of Sport and Exercise Psychology, 33*(4), 527-547.

Hox, J., van de Schoot, R., & Matthijsse, S. (2012). How few countries will do? Comparative survey analysis from a Bayesian perspective. Survey Research Methods, 6, 87-93.

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology, 102*(3), 588.

Kaplan, D., & Depaoli, S. (2012). Bayesian structural equation modeling. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 650-673). New York, NY: Guilford Press.

Kristiansen, E. (2017). Walking the line: How young athletes balance academic studies and sport in international competition. *Sport in Society, 20*(1), 47-65.

Kristiansen, E., & Houlihan, B. (2017). Developing young athletes: The role of private sport schools in the Norwegian sport system. *International review for the sociology of sport, 52*(4), 447-469.

Langan, E., Blake, C., & Lonsdale, C. (2013). Systematic review of the effectiveness of interpersonal coach education interventions on athlete outcomes. *Psychology of Sport & Exercise, 14*(1), 37-49.

Love, J., Selker R., Marsman M., Jamil T., Verhagen, A. J., Ly A., et al. (2015). JASP (Version 0.8.5).

Mageau, G., & Vallerand, R. (2003). The coach-athlete relationship: A motivational model. *Journal of Sports Sciences, 21*(11), 883-904.

Matosic, D., Ntoumanis, N., & Quested, E. (2016). Antecedents of need supportive and controlling interpersonal styles from a self-determination theory perspective: A review and implications for sport psychology research. In M. Raab, P. Wylleman, R. Seiler, A.-M. Elbe & A. Hatzigeorgiadis (Eds.), *Sport and Exercise Psychology Research* (pp. 145-180). Amsterdam: Academic Press.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge: Cambridge University Press.

Mayer, R. E. (2011). *Applying the science of learning*. Boston: Pearson.

Muthén, B., & Asparouhov, T. (2012). Bayesian structural equation modeling: A more

flexible representation of substantive theory. *Psychological Methods*, 17(3), 313-335.

Muthén, L. K., & Muthén, B. O. (1998–2017). *Mplus user's guide* (8nd ed.). Los Angeles, CA: Muthén & Muthén.

Norges Toppidrettsgymnas [Norwegian College of Elite Sport]. (2018). *Om NTG* [about NTG]. Retrieved (08.02.2018) from http://ntg.no/artikkel/om-ntg

Ntoumanis, N. (2012). A self-determination theory perspective on motivation in sport and physical education: Current trends and possible future research directions. In G. C. Roberts & D. C. Treasure (Eds.), *Advances in motivation in sport and exercise* (Vol. 3, pp. 91-128). Champaign, IL: Human Kinetics.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Briere, N. M. (2001). Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion, 25*(4), 279-306.

Reeve, J., & Deci, E. L. (1996). Elements of the competitive situation that affect intrinsic motivation. *Personality and Social Psychology Bulletin, 22*(1), 24-33.

Reinboth, M., Duda, J. L., & Ntoumanis, N. (2004). Dimensions of coaching behavior, need satisfaction, and the psychological and physical welfare of young athletes. *Motivation and Emotion, 28*(3), 297-313.

Rocchi, M. A., Pelletier, L., & Desmarais, P. (2017). The validity of the Interpersonal Behaviors Questionnaire (IBQ) in sport.

Measurement in Physical Education and Exercise Science, 21(1), 15-25.

Rocchi, M. A., Pelletier, L. G., & Couture, A. L. (2013). Determinants of coach motivation and autonomy supportive coaching behaviours. *Psychology of Sport & Exercise, 14*(6), 852-859.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Ryan, R. M., & Deci, E. L. (2008). From ego depletion to vitality: Theory and findings concerning the facilitation of energy available to the self. *Social and Personality Psychology Compass, 2*(2), 702-717.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. New York: Guilford Publications.

Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality, 65*(3), 529-565.

Ryan, R. M., & Huta, V. (2009). Wellness as healthy functioning or wellness as happiness: The importance of eudaimonic thinking (response to the Kashdan et al. and Waterman discussion). *The Journal of Positive Psychology, 4*(3), 202-204.

Sánchez-Oliva, D., Garcia-Calvo, T., Sánchez-Miguel, P. A., Amado, D., & Ntoumanis, N. (2016). *Development of a questionnaire to assess the basic psychological needs support in physical education classes*. Retrieved (08.02.2018) from: https://www.researchgate.net/profile/David_Sanchez-Oliva/publication/258911401_Development_of_a_Questionnaire_to_assess_the_Basic_Psychological_Needs_Support_in_Physical_Education_Classes/links/00b495296282837524000000/Development-of-a-Questionnaire-to-assess-the-Basic-Psychological-Needs-Support-in-Physical-Education-Classes.pdf

Song, X.-Y., & Lee, S.-Y. (2012). A tutorial on the Bayesian approach for analyzing structural equation models. *Journal of Mathematical Psychology, 56*(3), 135-148.

Stenling, A., Ivarsson, A., Johnson, U., & Lindwall, M. (2015). Bayesian structural equation modeling in sport and exercise psychology. *Journal of Sport and Exercise Psychology, 37*(4), 410-420.

Stenling, A., Ivarsson, A., & Lindwall, M. (2017). The only constant is change: analysing and understanding change in sport and exercise psychology research. *International Review of Sport and Exercise Psychology, 10*(1), 230-251.

Stenling, A., Lindwall, M., & Hassmén, P. Changes in percievd autonomy support, need satisfaction, motivation, and well-being in young elite athletes. *Sport, Exercise, and Performance Psychology, 4*, 50-61. doi:10.1037/spy0000027

Stenling, A., Ivarsson, A., Johnson, U., & Lindwall, M. (2015). Bayesian Strucural Equation Modeling in Sport and Exercise Psychology. Journal of Sport and Exercise Psychology, 37, 410-420.

Su, Y. L., & Reeve, J. (2011). A meta-analysis of the effectiveness of intervention programs designed to support autonomy. *Educational Psychology Review, 23*(1), 159-188.

Taylor, I. M., & Ntoumanis, N. (2007). Teacher motivational strategies and student self-determination in physical education. *Journal of Educational Psychology, 99*(4), 747.

Tessier, D., Sarrazin, P., & Ntoumanis, N. (2010). The effect of an intervention to improve newly qualified teachers' interpersonal style, students motivation and psychological need satisfaction in sport-based physical education. *Contemporary Educational Psychology, 35*(4), 242-253.

Treasure, D. C., Lemyre, N., Kuczka, K. K., & Standage, M. (2007). Motivation in elite sport: A self-determination perspective. In M. S. Hagger & N. Chatzisarantis (Eds.), *Intrinsic Motivation and Self-Determination in Exercise and Sport* (pp. 153-165). Champaign, IL: Human Kinetics.

Vansteenkiste, M., & Deci, E. L. (2003). Competitively contingent rewards and intrinsic motivation: Can losers remain motivated? *Motivation & Emotion, 27*(4), 273-299.

Yuan, Y., & MacKinnon, D. P. (2009). Bayesian mediation analysis. *Psychological methods, 14*(4), 301.

Zyphur, M. J., & Oswald, F. L. (2015). Bayesian estimation and inference: A user's guide. *Journal of Management, 41*(2), 390-420.