

Conceptualizing and testing a new tripartite measure of coach interpersonal behaviors

Nikita Bhavsar^{a,b}, Nikos Ntoumanis^{a,b,*}, Eleanor Qusted^{a,b}, Daniel F. Gucciardi^{b,c},
Cecilie Thøgersen-Ntoumani^{a,b}, Richard M. Ryan^d, Johnmarshall Reeve^d, Philippe Sarrazin^e,
Kimberley J. Bartholomew^f

^a School of Psychology, Curtin University, Australia

^b Physical Activity and Well-Being Lab, Curtin University, Australia

^c School of Physiotherapy and Exercise Science, Curtin University, Australia

^d Institute for Positive Psychology & Education, Australian Catholic University, Australia

^e SENS, Univ. Grenoble-Alpes, France

^f School of Education and Lifelong Learning, University of East Anglia, UK

ARTICLE INFO

Keywords:

Self-determination theory
Scale development
Exploratory structural equation modeling
Psychometric testing
Need support
Need thwarting

ABSTRACT

Objectives: Various self-report measures based on Self-Determination Theory (Deci & Ryan, 1985; Ryan & Deci, 2017) have been developed to assess athletes' perceptions of their coaches' need supportive and thwarting behaviors. We propose that it is also conceptually important to distinguish between coaching behaviors that thwart and those that are indifferent to athletes' psychological needs. This distinction is useful, as we contend that athletes' degree of need frustration, and concomitant negative outcomes, are likely to be more pronounced in a coaching environment that actively thwarts (vs. is indifferent to) athletes' needs. In this three-study paper, we outline the conceptual rationale for, the development of, and initial validity evidence for a tripartite (need supportive, thwarting, and indifferent) measure of interpersonal behaviors of coaches (TMIB-C).

Method: In Study 1, we developed 54 candidate items and gathered evidence for their face and content validity with athletes and an expert panel. Competing factor models were tested in Study 2 to determine the best representation of the measure's factor structure. In Study 3, we tested the replication of such models and the nomological network surrounding the identified factors.

Results: In Study 2, a 22-item, three-factor structure (supportive, thwarting, and indifferent behaviors) using exploratory structural equation modeling, demonstrated acceptable fit, good standardized factor loadings, factor correlations in the expected directions, and acceptable estimates of internal consistency. This model was replicated in Study 3. Tests of nomological networks showed that as expected, need indifference was a weaker predictor of autonomy and competence need frustration as compared to need thwarting, and the only significant predictor of irrelevant thoughts. Unexpectedly however, need indifference, when compared to need thwarting, was as good a predictor of exhaustion and a better predictor of relatedness frustration.

Conclusions: Evidence supports the TMIB-C as a parsimonious and promising measure of athletes' perceptions of coach interpersonal behaviors. Our tripartite conceptualization and measure should be further tested in terms of its predictive utility in order to advance conceptual understanding and intervention efforts targeting interpersonal behaviors in sport, and potentially other life domains.

"I never found anyone who fulfilled my needs, a lonely place to be"

1. Introduction

Whitney Houston eloquently sang about how behaviors of others

can sometimes be inadequate to fulfil one's needs in her rendition of Michael Masser and Linda Creed's 1976 song, "The Greatest Love of All". With respect to psychological needs, Self-determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017) based researchers have, to date, examined behaviors of individuals in key positions (e.g., coaches) that are supportive or thwarting of others' (e.g., athletes') basic

* Corresponding author. Physical Activity and Well-being Lab, School of Psychology, Curtin University, GPO Box U1987, Perth, Western Australia, 6845, Australia.
E-mail address: nikos.ntoumanis@curtin.edu.au (N. Ntoumanis).

psychological needs. However, as illustrated by the above lyrics, an individual may also find himself/herself in situations where significant others are unfulfilling of, or indifferent to his/her needs. In this paper, for the first time in the SDT literature, we propose and measure such need indifferent behaviors, and we contextualize our research within the domain of sports coaching.

In sport, it is commonly acknowledged that the coach plays a key role in shaping their athletes' performance, and the quality of their psychological experiences (Adie, Duda, & Ntoumanis, 2012; Mageau & Vallerand, 2003). A number of self-report measures exist that draw from SDT to assess athletes' perceptions of their coaches' interpersonal behaviors (the terms "behaviors" and "styles" have often been used interchangeably e.g., Pulido, Sánchez-Oliva, Leo, Sánchez-Cano, & García-Calvo, 2018; Rocchi, Pelletier, & Desmarais, 2017). A broad distinction has been made between adaptive ("need supportive") and maladaptive ("need thwarting") interpersonal behaviors (e.g., Hancox, Quested, Thøgersen-Ntoumani, & Ntoumanis, 2015; Ntoumanis, Quested, Reeve, & Cheon, 2018), which can be further classified into behaviors that are need-specific (e.g., autonomy, competence, and relatedness supportive, and autonomy, competence, and relatedness thwarting).

In this three-study paper, we further distinguish between coaching behaviors that actively undermine athletes' psychological needs and those that are indifferent to such needs. We explain why such a distinction can provide a more refined conceptual understanding of (coaching) interpersonal behaviors with potential applied implications, and how each behavior might relate to different outcomes for athletes. To this end, we present the development of, and initial validity evidence for, a new tripartite measure of athletes' perceptions of their coaches' supportive, thwarting, and indifferent interpersonal behaviors.

1.1. Self-determination theory and coach interpersonal behaviors

Coaches exhibit characteristics of need supportive interpersonal behaviors when they communicate with athletes in ways that are supportive of their basic psychological needs for autonomy, competence, and relatedness. Social agents use *autonomy supportive behaviors* when they recognize and nurture others' inner motivational resources, such as their goals and preferences (Katz & Assor, 2007; Reeve, 2009). For instance, coaches can be autonomy supportive by offering athletes choices within agreed boundaries, showing attempts to understand their perspectives, providing them with personally meaningful rationales for task engagement, encouraging their input in decision making processes, and giving them opportunities for self-initiated behavior (Mageau & Vallerand, 2003; Ntoumanis & Mallett, 2014).

Competence support has previously been described under the term "structure" in the SDT literature (e.g., Curran, Hill, & Niemiec, 2013; Grolnick & Ryan, 1989; Mageau & Vallerand, 2003; Skinner, Johnson, & Snyder, 2005), referring to how social agents can convey clear expectations and information to others to help them reach desired goals and outcomes. Competence support also involves behaviors that guide individuals in feeling capable of tackling challenging situations and/or experiencing meaningful success (Matosic, Ntoumanis, & Quested, 2016). This can be done by helping them to set realistic goals, by providing constructive and thorough feedback (Ntoumanis & Mallett, 2014), and encouraging learning and improvement of skills (Rocchi et al., 2017).

Relatedness supportive behaviors have been described using the terms "interpersonal involvement" (e.g., Grolnick & Ryan, 1989) and "warmth" (e.g., Skinner et al., 2005) in the SDT literature to refer to demonstrations of caring, affection, and emotional availability. Coaches can support their athletes' sense of relatedness by being empathetic, showing interest, and providing them with care and support (Pulido et al., 2018; Rocchi et al., 2017).

Through a plethora of studies, researchers have demonstrated positive associations between athletes' perceptions of coach need

supportive interpersonal behaviors and athletes' basic psychological need satisfaction (Adie et al., 2012), self-determined forms of motivation (Amorose & Anderson-Butcher, 2007), and positive outcomes such as well-being (Adie, Duda, & Ntoumanis, 2008), persistence (Pelletier, Fortier, Vallerand, & Briere, 2001), and improved performance (Cheon, Reeve, Lee, & Lee, 2015).

In contrast, coaches adopt need thwarting interpersonal behaviors when they communicate with athletes in ways that undermine their needs for autonomy, competence, and relatedness. *Autonomy thwarting behaviors* (also known as "controlling" coaching behaviors, e.g., Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010) include those that pressure others to think, feel, and behave in set manners, and which are dismissive of, or devalue, others' perspectives (Reeve, 2009). Coaches can thwart their athletes' need for autonomy by applying excessive personal control in situations that are not directly relevant to athletes' sport participation, and using coercive strategies so that tasks are performed in certain ways, by using intimidating language, employing rewards to control athletes' behaviors, and being conditionally accepting (Bartholomew et al., 2010).

Competence thwarting has previously been described using the term "chaos" in the SDT literature (e.g., Skinner et al., 2005; Smith, Quested, Appleton, & Duda, 2016). According to Skinner et al. (2005), chaotic behaviors are inconsistent, disorganized, confusing, and lacking in direction. Competence thwarting has also been discussed in relation to highlighting others' failures and conveying incompetence information to them (Sheldon & Filak, 2008). Coaches can thwart their athletes' need for competence by showing doubt in their capacity to improve in their sport, emphasizing their mistakes, being overly critical of them, and by repeatedly giving them negative feedback in public (Pulido et al., 2018; Rocchi et al., 2017).

Relatedness thwarting behaviors have previously been described as "being cold" (e.g., Skinner et al., 2005), for instance, by being aloof and inattentive towards others, or being unavailable when needed. Relatedness thwarting behaviors have also been described using the term "rejection" (e.g., Skinner et al., 2005), exemplified by demonstrating aversion and active dislike towards others. Coaches can also thwart their athletes' sense of relatedness by being critical and hostile towards them, and purposefully excluding them from activities (Standage, Curran, & Rouse, 2019).

Athletes' perceptions of coaches' need thwarting interpersonal behaviors have been associated with athlete need frustration (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011; Haerens et al., 2018), non-self-determined forms of motivation (i.e., driven by contingencies, guilt, rules and demands; Pelletier, Fortier, Vallerand, & Briere, 2001; Rocchi et al., 2017), and negative outcomes such as somatic anxiety, worry, and concentration disruption (Ramis, Torregrosa, Viladrich, & Cruz, 2017).

1.2. The case for coach need indifferent interpersonal behaviors

Besides actively nurturing or undermining others' experiences of need satisfaction, social agents have also been described as being indifferent (Vansteenkiste & Ryan, 2013). However, existing conceptualizations and measures of maladaptive interpersonal behaviors do not distinguish between a behavior that reflects "active" or "direct" need thwarting by the social agent (e.g., coaches intimidating athletes), and a behavior that is "neutral", "passive", or "indifferent" to athletes' needs (e.g., coaches being unresponsive to athletes' opinions).

As an example, consider the conceptualization of, and the items assessing the construct of chaos, which is usually offered as an illustration of competence thwarting. In the parenting literature, chaos refers to parenting that is permissive and erratic (Skinner et al., 2005). A sample item for this dimension, from the Parent as Social Context Questionnaire (Skinner, Wellborn, & Regan, 1986), is "When my parents say they will do something, sometimes they don't really do it". Although such behaviors might impede others' in their goal

achievement process, they differ from need thwarting behaviors, which describe situations where one's needs are "actively blocked" by a person in authority (Vansteenkiste & Ryan, 2013). Thus, the conceptualization and measurement of chaotic behaviors is more akin to need indifferent behaviors, rather than need thwarting ones. An example of the latter would be a coach delivering scathing feedback to an athlete, criticizing his/her competence in front of the entire team. Confounds of need thwarting and need indifferent behaviors can also be found in the sport literature. For example, the conceptualization of competence thwarting by Pulido et al. (2018) includes chaotic coaching behaviors, such as instances when coaches supply athletes with a lot of information that is lacking in structure and clear objectives, resulting in athletes failing to understand their tasks and responsibilities.

Similar problems exist with the conceptualization and measurement of the construct of cold behaviors, which is often described as relatedness thwarting (e.g., Pulido et al., 2018; Rocchi et al., 2017; Skinner et al., 2005). Cold behaviors include being distant with others, unavailable when needed, disinterested in others' thoughts and feelings, and not listening to what others have to say (Pulido et al., 2018; Rocchi et al., 2017; Sheldon & Filak, 2008). This conceptualization is ambiguous, as it is not clear if being cold is the result of being disinterested or weary of others (which is more of a relatedness indifferent behavior), or due to hostility, rejection, or conditional regard towards others, which are characteristics of relatedness thwarting (Standage et al., 2019; Vansteenkiste & Ryan, 2013).

Only a few attempts have been made to include need "neutral" items in SDT-informed experiments, all outside of sport (e.g., Kinnafick, Thøgersen-Ntoumani, & Duda, 2016; Tessier, Sarrazin, & Ntoumanis, 2008). However, there was no strong theoretical explanation in these papers as to what such "neutral" behaviors represented, and how they related to psychological needs and key motivation-related outcomes.

Recently, Quested, Ntoumanis, Stenling, Thøgersen-Ntoumani, and Hancox (2018) made a case for need indifferent behaviors in developing the Need-Relevant Instructor Behaviors Scale (NIBS), an observational scale to assess need supportive, thwarting, and indifferent behaviors of exercise instructors. The researchers theorized need indifferent behaviors as being deficient of any need supportive or need thwarting attributes. An example is that of an exercise class instructor shouting "keep going" to the exercise class participants, without any empathy, enthusiasm, or specific feedback. It should be noted, however, that the NIBS has been developed in the context of group exercise, and, more importantly, is an observational measure, aiding the "objective" assessment of the socio-contextual environment. Within the SDT framework, it is the subjective interpretation of the socio-contextual environment that is purported to influence individuals' behaviors and related outcomes, and thus, self-report measures that capture perceptions of need indifferent behaviors are also needed.

In this paper, we propose that besides employing need supportive and need thwarting behaviors, coaches can also adopt need indifferent behaviors towards their athletes. Need indifference is demonstrated when a coach is inattentive to his/her athletes' basic psychological needs. Need indifferent behaviors are proposed to be less motivationally damaging in comparison to need thwarting behaviors, because they do not actively undermine the three psychological needs.

Autonomy indifference comprises of behaviors where a coach shows disinterest in athletes' perspectives, wants, and preferences. Coaches can be indifferent towards their athletes' need for autonomy by, for example, being unresponsive to their opinions. *Competence indifference* consists of behaviors illustrating negligence from the coach in creating conditions that will help athletes to progress, and feel capable and successful. One way in which coaches can be indifferent to their athletes' need for competence is by creating a chaotic environment, or by setting uniform tasks that do not take into consideration athletes' differences in skill level. Finally, *relatedness indifference* involves behaviors exemplifying inattentiveness from the coach towards the quality of the coach-athlete relationship. Keeping to themselves without asking

questions about athletes' welfare is one way in which coaches could be indifferent towards athletes' need for relatedness.

This distinction between need thwarting and need indifferent coach interpersonal behaviors has important implications. Specifically, need thwarting coach interpersonal behaviors might relate more strongly to athlete need frustration than need indifferent coach interpersonal behaviors. Further, indifferent and thwarting coaching behaviors could predict athletes' behavior, cognition, and affect differently. For example, we propose that, because need indifferent behaviors do not actively block athletes' needs, they will better predict "less deleterious/dark" outcomes (e.g., athlete disengagement, as represented by sport irrelevant thoughts or boredom), compared to those predicted by need thwarting (e.g., exhaustion, debilitating competitive anxiety). In sum, we propose that coaches can adopt behaviors that are need supportive, need thwarting, and need indifferent, which could potentially have unique implications in terms of athlete need satisfaction and frustration, motivation, and well-being/ill-being. As such, it would be worthwhile to measure these behaviors simultaneously.

1.3. Self-report questionnaires to measure interpersonal behaviors in sport and other life settings

The conceptualization of the three basic psychological needs within the SDT framework is unique, such that even though each need is considered to be important in its own right, all three needs are regarded as interdependent and expected to be highly correlated (Ryan & Deci, 2017). Accordingly, examinations of the dimensionality of interpersonal behaviors targeting these needs have been guided by two approaches. The first is a unidimensional approach, where items assessing all three needs are presented as a single factor. The second is a multidimensional approach, where items pertaining to each of the three needs are presented as distinct factors.

With regard to the first approach, researchers have presented a one-factor model of "need support" that includes items assessing the support of all three needs (e.g., Health Care Climate Questionnaire, HCCQ; Williams, Grow, Freedman, Ryan, & Deci, 1996; Need Support for Exercise Scale, NSE; Markland & Tobin, 2010; Needs-Support Behaviors Scale, NSBS; Gucciardi, Weixian, Gibson, Ntoumanis, & Ng, in press). Through personal communication, we have established that the unidimensional approach was taken on the basis of very high factor correlations when a three-factor approach was tested (E. Deci, personal communication, September 3, 2015, in relation to the HCCQ by Williams et al., 1996; D. Markland, personal communication, July 3, 2017, in relation to the NSE by Markland & Tobin, 2010). High correlations between factors raise uncertainty regarding the discriminant validity evidence of the subscale scores of an instrument. In their paper, Gucciardi et al. (in press) reported poor discriminant validity evidence for a multi-dimensional structure of need support. In sport, correlations as high as 0.94 have been observed between the factors of the Interpersonal Supportiveness Scale-Coach (ISS-C; Wilson, Gregson, & Mack, 2009), which assess perceived autonomy support, structure, and involvement, indicating substantial overlap between the items of these subscales.

With regards to the multidimensional approach to measuring coach behaviors, the Interpersonal Behaviors Questionnaire in Sport (IBQ in Sport; Rocchi et al., 2017) is a 24-item six-factor measure of autonomy, competence, and relatedness support and thwarting. This six-factor scale was developed through a series of sequential Confirmatory Factor Analyses (CFA). Although CFA is suitable for scale development efforts with strong theoretical underpinnings (Hurley et al., 1997), it has a stringent requirement of zero cross-loadings of items on non-intended factors (Asparouhov & Muthén, 2009). This requirement often results in the elimination of conceptually relevant items that cross-load on unintended factors, and leads to inflated correlations among factors. For example, moderately high correlations around 0.74 have been reported between the need support subscales of the IBQ in Sport. Further, the

IBQ in Sport uses items that refer to potentially relatedness indifferent interpersonal behaviors (e.g., “My coach is distant when we spend time together”, “My coach does not connect with me”) in order to assess relatedness thwarting.

Another recently developed multidimensional measure is the Coaches Interpersonal Style Questionnaire (CIS-Q; Pulido et al., 2018). The 22-item, six-factor questionnaire also assesses coach supportive and thwarting interpersonal behaviors for each of the needs of autonomy, competence, and relatedness. Although Pulido and colleagues used contemporary methods (i.e., ESEM) in their scale development effort, they also reported moderately high factor correlations between relatedness and competence support ($r = .78$), and between relatedness and competence thwarting ($r = .75$). Further, this scale was developed with male athletes, from a single sport (soccer), with no evidence of replication of this factor structure with an independent sample of athletes. Another limitation of the measure is that all of the items in the competence thwarting subscale, and few in the relatedness thwarting subscale appear to capture athletes’ experiences of need frustration, instead of coach behaviors that are competence/relatedness thwarting (e.g., During practices, our coach “... proposes situations that make me feel incapable”, “... makes me feel rejected by him/her sometimes”). The relatedness thwarting subscale of the CIS-Q also includes an item that reflects need indifference as opposed to need thwarting (“During practices, our coach ... is sometimes indifferent to me”).

The “helicopter” model (Aelterman et al., 2018) is a new perspective to measuring interpersonal behaviors. Delrue et al. (2019) took this to assess (de)motivating coaching behaviors associated with autonomy support, structure, control, and chaos. The researchers first developed a vignette-based instrument, the Situations-in-Sport Questionnaire using multidimensional scaling. Results showed that the four coach behaviors were best organized along two dimensions of a) need supportiveness and thwarting, and b) high and low directiveness, which classified the behaviors into four quadrants in a circular structure. Autonomy support, structure, control, and chaos were further divided into two sub-areas each (i.e., participative and attuning, guiding and clarifying, demanding and domineering, and abandoning and awaiting, respectively). Instead of considering coach behaviors as distinct (as has previously been the case in the SDT literature), the researchers presented a more refined and intertwined perspective, whereby combinations of different behaviors are more or less supportive or thwarting of athletes’ needs. However, some coach behaviors are not assessed by the Situations-in-Sport Questionnaire. Specifically, coach behaviors relevant to the support or thwarting of the need for relatedness or the thwarting of competence are missing.

Table 1
Initial Definitions for Nine Dimensions of Coach Behaviors (to Facilitate) Item Creation.

Coach Behaviors	Initial definitions
Autonomy Supportive	Autonomy supportive behaviors on part of the coach involve identification, nurture, and development of athletes’ inner motivational resources (Katz & Assor, 2007; Reeve, 2006) by prioritization and understanding of their perspectives (Reeve, 2009).
Autonomy Thwarting	Autonomy thwarting behaviors on part of the coach entail pressure for the athletes to think, feel, and behave in set ways, and involve dismissal or devaluation of athletes’ perspectives (Reeve, 2009).
Autonomy Indifferent	Autonomy neglecting* behaviors on part of the coach involve negligence or inattention towards athletes’ perspectives and their inner motivational resources.
Competence Supportive	Competence supportive behaviors on part of the coach involve guidance to aid athletes feel capable of facing challenging situations and/or experiencing success (Matosic et al., 2016).
Competence Thwarting	Competence thwarting behaviors on part of the coach entail communicating incompetence to the athletes, doubting their improvements, and highlighting their faults (Sheldon & Filak, 2008).
Competence Indifferent	Competence neglecting behaviors on part of the coach involve negligence or inattention towards providing adequate guidance, feedback, and organization to help athletes feel capable of facing challenges and/or experiencing success.
Relatedness Supportive	Relatedness supportive behaviors on part of the coach involve fostering a sense of connectedness with the athletes (Vansteenkiste, Niemiec, & Soenens, 2010).
Relatedness Thwarting	Relatedness thwarting behaviors on part of the coach entail active dislike or hostility towards the athletes (Skinner et al., 2005).
Relatedness Indifferent	Relatedness neglecting behaviors on part of the coach involve negligence or inattention towards promoting a sense of connectedness with the athletes.

Note. *Originally, the research team had proposed the label “neglect” for the new set of behaviors. It was, however, later changed to “indifferent”.

1.4. Present research

The objective of the present series of studies was to develop and provide initial validity evidence for a new multidimensional measure of athletes’ perceptions of their coaches’ need supportive, thwarting, and indifferent interpersonal behaviors. We named this measure the Tripartite Measure of Interpersonal Behaviors-Coach (TMIB-C). Over three studies, we examined various sources of validity evidence outlined by *The Standards for Educational and Psychological Testing* (The Standards; developed by the American Educational Research Association [AERA], American Psychological Association [APA], and National Council on Measurement in Education [NCME], 2014). In Study 1, we focused on item creation and selection, in addition to face and content validity evidence for the items of the new measure. In Study 2, we provided evidence for the internal structure of the measure by comparing several theoretically justifiable factorial models using CFA, ESEM, and bifactor CFA and ESEM. We also provided evidence for the reliability and discriminant validity of the subscale scores. Finally, in Study 3, we re-tested the factorial structure of the scale with an independent sample and provided initial evidence for its nomological validity.

2. Study 1

In Study 1 we aimed to (a) create a pool of items to assess coach behaviors that would be supportive, thwarting, and indifferent to each of the three needs; (b) test the face validity evidence of the items by pilot testing them with athletes to explore their perceptions of the items’ relevance to the sport domain as well as the clarity of wording; and (c) test the content validity evidence of the scores of the selected item pool by consulting a panel of experts.

3. Method

We searched electronic databases to identify existing self-report and observational SDT-informed measures of interpersonal behaviors/socio-contextual environment in the areas of sport, exercise, education, and parenting. Keywords included “need support”, “need supportive climate”, “autonomy support”, “controlling”, “need thwarting”, “observed need thwarting”, “motivational climate”, “interpersonal style”, and “self-determination theory”. Twelve measures were identified through this search, and inspection of their reference lists led to the identification of 10 additional measures (see Supplementary File 1). Items of these twelve measures were collated to form the initial pool of 359 items.

An important initial step in developing measurement instruments is

creating a clear and sufficiently detailed narrative for the constructs of interest (Clark & Watson, 2019). We adapted existing definitions or conceptualizations of need supportive and thwarting behaviors, and wrote new definitions for need indifferent behaviors (see Table 1). Removal of duplicate items, similarly worded items, and items that were deemed unsuitable for a self-report measure specific to coaching, resulted in a reduced pool of 42 items. We subsequently classified these items as being supportive (18 items), thwarting (17 items), or indifferent (seven items) towards the three needs. We modified the wording of the original items in order to make them suitable for sport. The need indifferent items were items that were originally proposed as need thwarting by the researchers who developed the included scales (e.g., “My coach lets things get chaotic”). Based on the definitions developed for the purpose of this study, however, we classified this as being indifferent. In addition, we created nine new items, for example “My coach keeps to himself/herself”, to tap need indifferent behaviors. In order to maximize the quality of these items, we followed guidelines for item wording (DeVellis, 2012). Namely, we ensured that the items were straightforward, easy to read for the target population, brief, and avoided items that were double-barreled or items with nearly identical content. Through this process, we created an initial pool of 51 items. The perceived relevance to sport and clarity of the items in this pool was subsequently tested in a group of athletes, and after further changes, by a panel of SDT experts.

3.1. Participants

The athlete sample ($N = 20$) consisted of six female and 14 male Australian athletes, who were, on average, 19.70 years of age ($SD = 2.83$). Athletes represented individual and team sports including Australian football (AFL), rugby, athletics, netball, lacrosse, rowing, karate, soccer, and basketball. Athletes were competitive at the club ($n = 11$), state ($n = 7$), or national ($n = 2$) level. Average competitive experience was 7.55 years ($SD = 4.717$). On average, athletes trained 2.90 times a week ($SD = 1.74$) and had been training with their current main coaches for 1.79 years ($SD = 1.61$).

Following further changes to the item pool based on athlete feedback, we sent requests to 15 academics to test the content validity of the item pool; eight of whom accepted the invitation. These academics from five countries, were experts in SDT, with experience in scale development, and track records of publishing relevant research in the fields of sport and exercise psychology, education, work, or parenting.

3.2. Procedure

After gaining ethical approval for all three studies in this paper from the principal researcher's University Ethics Committee, we contacted coaches and management committees of sporting bodies in Perth, Western Australia, to request that they invite their athletes to participate. To be eligible, athletes were required to be over 14 years of age, train with a coach at least once a week, compete regularly during the sport season, and be proficient in English. The purpose of the study was explained to interested athletes before they were invited to participate in a semi-structured interview. Prior to interviews, we obtained written participant consent, and parental consent where appropriate.

The interviews allowed for collection of both quantitative and qualitative data. We presented the athletes with the pool of 51 items and requested them to consider their general experiences of the “manner” in which coaches (their own or those of others in the case that some of the items were inapplicable to their coach) interact with athletes. At first, we asked them to rate the relevance of each item to the sport domain using a dichotomous scale (*Applicable vs. Inapplicable*). For the items that were found to be applicable to sport (implying that coaches might communicate in such a manner), we further asked them to rate the items in terms of clarity, using a 7-point scale (1 = *not at all clear* to 7 = *very clear*). In cases where an item was rated below 5 on

clarity, a researcher discussed what was problematic with the athlete and asked them to share their thoughts on how to make the item (or part thereof) clearer. Finally, the researcher also encouraged the participants to describe any other coaching behaviors that they had experienced, which were not already represented by the item pool. Items were modified accordingly.

Next, we asked the SDT experts to rate the modified items to indicate the extent to which they thought each item matched its ascribed definition using a 5-point scale (1 = *poor match*, 5 = *excellent match*). Experts were requested to indicate if they thought any item also made a good, great or excellent match (i.e., ratings of 3, 4 or 5) for a non-intended factor, in an effort to identify items which could potentially cross-load in a future factor analysis. Finally, they were invited to share their opinions on alternative wording for items, propose additional items, and to provide feedback on the suggested definitions of need indifferent behaviors. We used the experts' ratings to calculate the Content Validity Index (CVI; Lynn, 1986) for each item and to reach decisions for retention, revision, or elimination of items. To calculate each item's CVI, we divided the number of experts who rated the item as a *good match*, *very good match*, or an *excellent match* (i.e. a rating of 3, 4 or 5) by the total number of experts on the panel.

4. Results and discussion

The athletes reported that all 51 coach behaviors were applicable to sport and that coaches interacted with athletes using the supportive, thwarting, and indifferent behaviors described by the 51 items. Three new items (one each for autonomy supportive, autonomy indifferent, and relatedness thwarting behaviors) were identified through the interviews and were added to the item pool. The wording for one item (for relatedness support) was rated as unclear and revised according to athlete feedback.

Following the expert panel review, 51 of the 54 items in the revised item pool exhibited a CVI that was over or in the vicinity of the agreement level proposed by Lynn (1986) for six or more experts (i.e. $CVI \approx 0.80$; see also Polit, Beck, & Owen, 2007). We made minor revisions to some of these items to accommodate experts' comments regarding item improvement. Although three items had low or very low CVIs (0.62, 0.35, and 0.25, respectively), these items were not deemed irrelevant or worthy of deletion in any of the experts' qualitative comments. As such, we decided to retain these items, modify their wording, and earmarked them for possible deletion in Study 2, if they were found to be problematic again.

4.1. Study 2

In Study 2, we aimed to (a) create a theoretically-based, parsimonious measure of supportive, thwarting, and indifferent coach interpersonal behaviors; (b) assess its factor structure using CFA, ESEM, and bifactor CFA and ESEM; and (c) examine the reliability and discriminant validity evidence of the subscale scores of the new measure.

5. Method

5.1. Participants

The sample ($N = 288$) consisted of 156 female and 132 male Australian athletes, with an average age of 17.93 years ($SD = 4.56$). Athletes represented individual ($n = 43$) and team ($n = 245$) sports, such as swimming, triathlon, tennis, netball, AFL, soccer, synchronized swimming, lacrosse, volleyball, baseball, water polo, and basketball. Athletes were competing at the club ($n = 235$), state ($n = 44$), national ($n = 7$), or international ($n = 2$) level. Average competitive experience was 9.71 years ($SD = 5.13$), with athletes had been training with their current main coach for an average of 1.36 years ($SD = 1.88$).

5.2. Procedure

We used procedures similar to those utilized in Study 1 to recruit athletes.

5.3. Measures

Tripartite Measure of Interpersonal Behaviors-Coach (TMIB-C).

We used the 54 items developed in Study 1 alongside a 7-point response format (1 = *strongly disagree*, 4 = *neither disagree nor agree*, 7 = *strongly agree*), which has also been employed by other measures of coach interpersonal behaviors (e.g., Rocchi et al., 2017). At the beginning of the questionnaire, participants were requested to consider their experiences with their current main coach during training and competitions over the past month, and to indicate the extent to which they disagreed or agreed with each statement, which began with the stem “My coach ...”. The researcher emphasized to the participants that every coach has his or her own style and no one style is necessarily better than the other, thus inviting them to be as honest as possible with their responses.

5.4. Data analyses

As there is theoretical and empirical support for modeling the broad interpersonal behaviors as a single factor (e.g., overarching dimension of need support), or according to need specific dimensions (e.g., autonomy, competence, and relatedness support), both of these approaches were used to inform our tests of the factorial structure of the TMIB-C. As previously mentioned, the stringent requirement in CFA of zero cross-loadings between items and non-intended factors results in overestimated factor correlations, a concern that may be dealt with using ESEM, bifactor models, or a fusion of the two (Morin, Arens, & Marsh, 2016). In ESEM, it is recognized that items may be associated with constructs other than those they are intended to measure (Morin et al., 2016). Thus, all cross-loadings can be estimated through the use of ESEM, resulting in factor correlations that are less inflated in comparison to those obtained via CFA (Asparouhov & Muthen, 2009). It is also important to test bifactor models (Holzinger & Swineford, 1937; Reise, 2012) in examining interpersonal behaviors. Substantively, a bifactor model enables one to test simultaneously the presence of a global factor that explains covariance among all items and specific dimensions that explain covariance among subsets of indicators that are distinct to the general construct (Chen, Hayes, Carver, Laurenceau, & Zhang, 2012). Practically, testing bifactor solutions and comparing them against CFA and ESEM solutions is useful in deciding whether global factors (e.g., need support) are accompanied by need-specific factors (autonomy, competence, & relatedness) or whether global factors are sufficient on their own. Lastly, bearing in mind that items are often associated with constructs other than the ones they are intended to measure, and also that items may tap a specific factor as well as a more global construct, a merger of ESEM with bifactor models enables the simultaneous examination of the presence of item cross-loadings as well as global and specific factors in a factorial structure. We thus tested twelve theoretically justifiable configurations of the factorial structure using CFA, ESEM, and bifactor CFA, and ESEM (See Table 2 and Supplementary File 2). All statistical analyses were conducted in Mplus 8.0 (Muthén & Muthén, 1998–2017).

In the CFA models, we allowed items to load on their predefined factors only, and suppressed cross-loadings on unintended factors. Factors were allowed to correlate. We used target rotation to test ESEM models. In other words, we defined factors in a manner similar to the CFA models, however, we allowed cross-loadings to be freely estimated while specifying them to be close to zero (Browne, 2001). In the case of the bifactor CFA models, we let items load on their predefined S-factors and G-factors. S-factors were specified as orthogonal. G-factors were allowed to correlate with one another in cases where there were two or more (A. Morin, personal communication, December 18, 2017). Finally,

we estimated the bifactor ESEM models in a manner similar to bifactor CFA models, however, we allowed for all cross-loadings for the S-factors to be freely estimated using an orthogonal target rotation (Reise, 2012).

We used a multi-faceted approach to assess the adequacy of model-to-data fit by evaluating the Chi-square (χ^2) goodness-of-fit index, Tucker-Lewis index (TLI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square (SRMR). Guided by typical recommendations (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004; Marsh, Hau, & Grayson, 2005), CFI and TLI values of or greater than 0.90 and 0.95 were considered to be indicative of adequate and excellent fit, respectively. SRMR and RMSEA values smaller than 0.08 and 0.06 were indicative of acceptable and excellent model fit, respectively.

We used the recommendations of Comrey and Lee (1992) to guide the assessment of strength of factor loadings (> 0.71 = “excellent”, > 0.63 = “very good”, > 0.55 = “good”, > 0.45 = “fair”, < 0.30 = “poor”). Raykov’s composite reliability coefficient (ρ ; Raykov, 1997) was used as an estimate of internal consistency for the subscale scores; values greater than 0.70 were considered acceptable (e.g., Nunnally, 1978). Evidence for discriminant validity was sought through an examination of correlations between the factors (Brown, 2015), where values ≥ 0.80 were deemed indicative of considerable overlap between the factors (John & Benet-Martínez, 2000).

6. Results and discussion

6.1. Item distribution

First, the scoring distributions of the 54 items were examined for univariate normality. Median values for skewness and kurtosis were 0.748 (range -4.307 to 0.146) and 1.228 (-1.090 to 20.774). The high positive kurtosis values for some items indicate that participant responses to these items were concentrated in the middle of the response scale and were sparse towards the tails (Tabachnick & Fidell, 2012). Departures from normality are common in the area of social and psychological sciences (Cain, Zhang, & Yuan, 2017). Subsequent analyses were conducted using a robust maximum likelihood estimator (MLR) which provides robust fit indices and standard errors in the case of non-normality and performs well with variables with a minimum of five response categories (Bandalos, 2014; Rhemtulla, Brosseau-Laird, & Savalei, 2012).

6.2. Factorial structure

Goodness-of-fit indices for all 12 models tested are reported in Table 2. None of the models achieved good fit and some did not converge. In terms of the ESEM models for potential nine-factor solutions, an examination of the parameter estimates further suggested multiple items with poor standard factor loadings (< 0.30) and/or unintended cross-loadings (> 0.20), the removal of which would result in only one or two items per interpersonal behavior. The only models that demonstrated clean fitting solutions in terms of zero to few cross-loadings between items and non-intended factors were ESEM model 5 (three factors) and bifactor ESEM model 12 (one general-factor and three specific-factors). Both these models also demonstrated acceptable standardized factor loadings and factor correlations in expected directions. In the case of the bifactor ESEM model 12, this structure also exhibited a well-defined G-factor as well as S-factors.

We thus decided to revert to the original item pool of 54 items in order to pull together items that would support either of these two solutions, with factors representing overall need supportive, thwarting, and indifferent coaching behaviors. Item selection began with one-factor CFAs for each of these three broad coach interpersonal behaviors. The CFA approach was justified in that the measure was based on a

Table 2
Goodness-of-Fit Statistics for Alternative CFA and ESEM Models Tested (Study 2).

Model	χ^2	<i>p</i>	<i>df</i>	CFI	TLI	SRMR	RMSEA [90% CI]
1. Three-factor CFA	3012.04	< .001	1374	.78	.77	.06	.06 [.06, .07]
2. Nine-correlated factors CFA	2918.54	< .001	1341	.79	.78	.059	.06 [.06, .07]
3. H-CFA(three-H, nine-L)	2965.38	< .001	1365	.79	.78	.06	.06 [.06, .07]
4. H-CFA(one-H, nine-L)	3442.54	< .001	1368	.73	.71	.08	.07 [.07, .08]
5. Three-factor ESEM	2960.48	< .001	1272	.78	.75	.054	.07 [.06, .07]
6. Nine-correlated factors ESEM	2055.47	< .001	981	.86	.79	.028	.06 [.06, .06]
7. Bifactor CFA (correlated three-G, nine-S)	DNC						
8. Bifactor CFA (one-G, nine-S)	DNC						
9. Bifactor CFA (one-G, three-S)	2825.63	< .001	1323	.80	.79	.08	.06 [.06, .06]
10. Bifactor ESEM (correlated three-G, nine-S)	1849.33	< .001	924	.88	.81	.030	.06 [.05, .06]
11. Bifactor ESEM (one-G, nine-S)	1902.53	< .001	936	.87	.80	.026	.06 [.06, .06]
12. Bifactor ESEM (one-G, three-S)	2578.88	< .001	1221	.82	.79	.042	.06 [.06, .06]

Note: χ^2 = Chi-square test of exact fit. *df* = degrees of freedom. *p* = probability. CFI = Comparative Fit Index. TLI = Tucker–Lewis index. SRMR = Standardized Root Mean Square Residual. RMSEA = Root Mean Square Error of Approximation. 90% CI = 90% confidence interval of the RMSEA. CFA = confirmatory factor analysis. H-CFA = Hierarchical CFA. H-factor = higher order factor estimated as a part of hierarchical model. L-factor = lower order factor estimated as a part of hierarchical model. ESEM = exploratory structural equation modeling. G-factor = global factor estimated as part of a bifactor model. S-factor = specific factor estimated as part of a bifactor model. DNC = did not converge

strong theoretical framework, and the aim of this analysis was to select items that load primarily on their intended constructs so as to have more distinct measures of the three broad interpersonal behaviors. After removing problematic items, our end goal was to re-run the three-factor ESEM Model (Model 5) and bifactor ESEM Model with one G-factor and three S-factors (Model 12), with the chosen items from the unidimensional CFAs, in order to achieve improved model-to-data fit.

As the mere retention of best-fitting items might not lead to a measure that is adequately representative of the target construct (Clark & Watson, 2019), our screening for model misspecification was conceptually and statistically informed. Conceptual details such as item overlap, the breadth of the concept, and adequate representation of items pertaining to each need were considered. Statistically, items with standardized factor loadings close to or below .30 and large modification indices (over 10), or multiple (two or more) moderate-sized modification indices were considered for deletion. Problematic items in each iteration were identified and removed from the analysis. We sought to ensure a balance of items of all three needs in each unidimensional model. We removed a total of 32 items through this process; 22 items were retained. The final unidimensional models for each of the three broad behaviors were found to have excellent fit and a balance of behaviors relevant to each of the three needs across each interpersonal behavior (see Table 3).

We subsequently re-ran Model 5 and Model 12 with the remaining 22 items.¹ The three-factor ESEM model was found to have acceptable fit [χ^2 (168) = 271.479, *p* < .001, CFI = 0.95, TLI = 0.93, RMSEA = 0.04 (90% CI 0.03 - 0.05), SRMR = 0.03]. Standardized factor loadings were significant and in the range of 0.48 and 0.88 and subscales related to each other in expected ways (see Table 4). None of the items had significant cross-loadings on unintended factors that were larger than the standard factor loading. Factor correlations between need thwarting and need supportive behaviors, need supportive, and need indifferent behaviors, and need thwarting and need indifferent behaviors were -0.67, -0.67, and 0.62, respectively. Raykov’s composite reliability coefficient (Raykov, 1997) was found to be 0.80 and above for all three subscales (see Table 5).

The bifactor ESEM model with one G- and three S-factors also

¹ The other 10 models were also re-run with these 22 items. Although the CFA models with nine-factor solutions reached acceptable fit indices, they were rejected on the basis of lack of sufficient items per factor. The three-factor CFA also demonstrated good fit, however, the three-factor ESEM model was preferred as it yielded lower factor correlations. The rest of the models did not converge or demonstrated poor standard factor loadings or multiple large unintended cross-loadings.

Table 3
Initial and Final Model Fit (Study 2).

Subscales	χ^2	<i>df</i>	<i>p</i>	CFI	TLI	SRMR	RMSEA [90% CI]
One-factor CFAs							
Need Supportive							
Initial (19)	431.13	152	.000	.87	.85	.05	.08 [.07, .09]
Final (8)	39.95	20	.005	.96	.95	.03	.06 [.03, .08]
Need Thwarting							
Initial (18)	430.56	135	.000	.81	.78	.08	.09 [.08, .09]
Final (8)	21.27	20	.381	.99	.99	.03	.01 [.00, .05]
Need Indifferent							
Initial (17)	363.49	119	.000	.86	.84	.06	.08 [.07, .09]
Final (6)	15.44	9	.079	.98	.96	.03	.05 [.00, .09]
ESEM							
Three-factor (22)	271.48	168	.000	.95	.93	.03	.05 [.04, .06]
Bifactor one-G three-S (22)	238.25	149	.000	.95	.93	.03	.05 [.03, .06]

Note. χ^2 = Chi-square, *df* = degrees of freedom. *p* = probability. CFI = comparative fit index. TLI = Tucker-Lewis Index. SRMR = Root Mean Square Residual. RMSEA = Root Mean Square Error of Approximation. () = number of items in model. Initial = the model with all items. Final = the model with the problematic items removed. CFA = confirmatory factor analysis. ESEM = exploratory structural equation modeling. G-factor = global factor estimated as part of a bifactor model. S-factor = specific factor estimated as part of a bifactor model.

demonstrated similar acceptable fit indices [χ^2 = 238.247 (149), *p* < .001, CFI = 0.95, TLI = 0.93, RMSEA = 0.05 (90% CI (0.03 - 0.06), SRMR = 0.03]. However, examination of factor loadings indicated that although there was a well-defined G-factor and S-factors for need supportive and indifferent behaviors, none of the items for the need thwarting behaviors had significant loadings. As such, a decision was made to retain the three-factor ESEM model (Model 5) and to re-test its factor structure with an independent sample of athletes.

Thus, at the end of Study 2, our assessment of coach interpersonal behaviors was informed by a tripartite approach (supportive, thwarting, and indifferent), which included a relative balance of behaviors tapping each of the three needs. Such an approach of collapsing the three needs into one overall score is in line with past measurement attempts (e.g., Markland & Tobin, 2010, and Williams et al., 1996 for need support), theoretically justified (see General Discussion), and it was a pragmatic choice as a nine-factor solution could not be established.

Table 4
Factor Loadings, Standard Errors, Means, SDs, Kurtosis and Skewness for the Final 22 Items in the Three-factor Model (Study 2).

Items	Factor loadings			SE	Means	SD	Skewness	Kurtosis
	NS	NT	NI					
STEM: <i>My coach ...</i>								
Need supportive behaviors								
Takes interest in my welfare. (R)	.75***			.09	5.73	1.29	-1.42	2.55
Shows that he/she understands my perspective. (A)	.85***			.07	5.47	1.23	-0.92	1.08
Ensures that tasks are suited to my skill level. (C)	.77***			.09	5.61	1.33	-1.21	1.56
Accepts me. (R)	.48***			.13	6.17	1.07	-1.46	2.16
Encourages me to take my own initiative. (A)	.67***			.10	5.87	1.17	-1.15	1.29
Shows care and concern. (R)	.57***		-.22*	.10	5.94	1.24	-1.37	1.76
Explains the reasons when he/she asks me to do something. (A)	.55***			.11	5.69	1.39	-1.31	1.54
Recognizes my efforts and accomplishments. (C)	.67***			.09	5.80	1.20	-1.18	1.45
Need thwarting behaviors								
Deliberately ignores me. (R)		.66***		.10	1.59	1.35	2.61	6.11
Makes it clear that I have little to contribute. (C)		.53***		.11	1.65	1.34	2.45	5.65
Tries to control everything I do. (A)		.67***		.08	1.63	1.18	2.31	5.31
Dismisses my opinion. (A)		.65***		.10	1.54	1.18	2.69	7.25
Blames me when things don't go well. (C)		.70***		.10	1.54	1.20	2.50	5.77
Makes it clear that he/she doesn't like me. (R)		.86***		.08	1.27	.90	4.00	16.76
Uses guilt tactics to control what I do. (A)		.88***		.08	1.35	.92	3.31	11.80
Belittles my abilities. (C)		.84***		.07	1.45	1.08	2.91	8.77
Need indifferent behaviors								
Keeps to himself/herself. (R)			.65***	.10	2.17	1.53	1.35	.96
Is unresponsive to my opinions. (A) (M)			.55***	.11	2.02	1.36	1.32	1.15
Sets activities that aren't challenging enough. (C) (M)			.64***	.12	2.33	1.51	1.08	.39
Is indifferent to how I feel. (R) (M)			.69***	.11	2.20	1.39	1.14	.78
Sets activities that lack variety. (A)			.65***	.10	2.45	1.60	1.06	.35
Can be disorganized. (C)			.61***	.12	2.24	1.52	1.19	.62

Note. *** $p < .001$, * $p < .01$. A = autonomy items; C = competence items; R = relatedness items. M = wording modified following three-factor ESEM. NS = need supportive behaviors, NT = need thwarting behaviors, NI = need indifferent behaviors. Target loadings are in bold. For clarity purposes, only cross-loadings over 0.20 are reported. SE = standard errors. SD = standard deviation.

Table 5
Correlations and Composite Reliability for the Three-Factor ESEM Model with 22-items (Study 2).

Subscales	Need Thwarting	Need Supportive	Need Indifferent
Need Thwarting	.90		
Need Supportive	-.67**	.86	
Need Indifferent	.62**	-.67**	.80

Note. Raykov's composite reliability coefficients are presented on the diagonal of the correlation matrix. ** $p < .001$.

7. Study 3

In Study 3, we first sought to re-test the three-factor ESEM structure that was favored in Study 2 in a new sample of athletes. Based on Study 2, we expected that the three-factor ESEM solution would hold when tested in a new sample of athletes. Subsequently, we sought to provide initial evidence for the nomological network surrounding the subscales of the TMIB-C by testing two different models for the relations between coach interpersonal behaviors and a) one positive (i.e., dedication) and two negative (i.e., exhaustion and irrelevant thoughts) athlete outcomes, and b) athlete need satisfaction and frustration. We chose dedication, exhaustion, and irrelevant thoughts as we were interested in examining the relations between interpersonal behaviors and conceptually relevant behavioral and cognitive outcomes. Based on past research linking need supportive and thwarting coach interpersonal behaviors, athlete need states, and outcomes of well-being and ill-being (e.g., Bartholomew et al., 2011; Pulido et al., 2018; Rocchi et al., 2017), we expected that sport dedication would be best predicted by need support. Exhaustion is a negative outcome that should be best predicted by need thwarting as it is an intensely adverse (“darker”) outcome. Irrelevant thoughts is also a negative outcome but not as strongly adverse as exhaustion, and would be best predicted by need indifference. We used outcomes that have commonly been used before (e.g.,

dedication, exhaustion), but also measures that haven't been examined in the SDT literature (e.g., irrelevant thoughts).

8. Method

8.1. Participants

The sample ($N = 352$) consisted of 169 female and 183 male competitive athletes, with an average age of 20.02 years ($SD = 5.88$). Athletes represented individual ($n = 76$) and team ($n = 276$) sports such as athletics, cycling, AFL, and netball. Most of the athletes were Australian ($n = 280$), and the remainder ($n = 72$) reported their ethnicities as European, South African, British, etc. Athletes were competitive at the club ($n = 159$), state ($n = 98$), national ($n = 62$), or international ($n = 33$) level. They had been competing in their respective sports for an average of 8.74 years ($SD = 4.81$), and had been training with their respective main coaches for an average of 2.31 years ($SD = 2.26$) on an average of 3.08 times per week ($SD = 1.75$).

8.2. Procedure

We recruited athletes using a procedure similar to that in Studies 1 and 2. Additionally, the questionnaire was made available online on the Qualtrics platform and was advertised through social media. All participating athletes were eligible to go in to a prize draw to win shopping vouchers. Undergraduate student-athletes ($n = 5$) at the School of Psychology at the first author's university were offered course credit for participation.

8.3. Measures

Athletes completed the following self-report measures either in-person ($n = 206$) or online ($n = 146$).

Coach Interpersonal Behaviors. The 22-item TMIB-C, developed

in Studies 1 and 2, was used to assess athletes' perceptions of their coaches' interpersonal behaviors. The measure consisted of three factors of need support, need thwarting, and need indifference. Similar to Study 2, athletes were requested to consider their experiences with their current main coach over the past month, and indicate the extent to which they disagreed or agreed with each statement using a 7-point response format.

Athlete Need Satisfaction and Frustration. The 24-item Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; [Chen et al., 2015](#)) was used to examine athletes' experiences of basic psychological need satisfaction and frustration. The measure consists of six subscales (with four items each) that examine the satisfaction and frustration of each of the three basic psychological needs. Some examples of items are “I feel capable at what I do” (competence satisfaction), and “I feel that people who are important to me are cold and distant towards me” (relatedness frustration). Athletes were asked to think about their experiences in sport and indicate the extent to which they disagreed or agreed with each statement using a 5 - point rating scale (1 = *not at all true*, 5 = *completely true*).

The factor structure of the measure was confirmed using CFA and ESEM. The ESEM model resulted in negative residual variance for one item (“I feel that my decisions reflect what I really want”). Fit indices for the CFA model were indicative of acceptable model-to-data fit [$\chi^2(236) = 503.278$, $p < .001$, CFI = 0.93, TLI = 0.91, RMSEA = 0.06 (90% CI 0.05–0.06), SRMR = 0.06]. Factor correlations were in the expected directions, ranging between -0.76 and 0.66. Raykov's composite reliability coefficients for the subscales were acceptable for all subscales (range 0.83–0.93). As such, the correlated six-factor CFA model was retained.

Positive and Negative Athlete Outcomes. The dedication subscale of the Athlete Engagement Questionnaire ([Lonsdale, Hodge, & Jackson, 2007](#)) was employed as a positive athlete outcome. The subscale consists of four items, to which participants responded using a 5-point rating scale (1 = *almost never*, 5 = *almost always*). An example item is “I am determined to achieve my goals in sport”. Fit for the single-factor CFA model was excellent [$\chi^2(2) = 4.650$, $p < .001$, CFI = 0.99, TLI = 0.99, RMSEA = 0.06 (90% CI 0.00 - 0.14), SRMR = 0.06]. Raykov's composite reliability coefficient for the subscale was 0.95.

The emotional/physical exhaustion subscale of the Athlete Burnout Questionnaire ([Raedeke & Smith, 2001](#)) was administered as an assessment of a “darker” athlete outcome. Participants responded to the five items that comprised the subscale using a 5-point response format (1 = *almost never*, 5 = *almost always*). An example of an item is “I have been feeling physically worn out from my sport”. Fit for the single-factor CFA model was sound [$\chi^2(5) = 34.355$, $p < .001$, CFI = 0.96, TLI = 0.93, RMSEA = 0.13 (90% CI 0.09 - 0.17), SRMR = 0.03]. Raykov's composite reliability coefficient for the subscale was 0.93.

Finally, the five-item irrelevant thoughts subscale of the Thought Occurrence Questionnaire for Sport (TOQS; [Hatzigeorgiadis & Biddle, 2001](#)) was used to assess cognitive interference (a “less dark” negative outcome). Participants responded to experiencing sport irrelevant thoughts about, for example, “Friends”, “Personal worries (e.g., school, work, relations)”, etc. using a 7-point response format (1 = *never*, 7 = *very often*). Fit for the single-factor CFA model was excellent [$\chi^2(5) = 21.449$, $p < .001$, CFI = 0.97, TLI = 0.95, RMSEA = 0.08 (90% CI 0.06 - 0.14), SRMR = 0.03]. Raykov's composite reliability coefficient for the subscale was 0.92.

8.4. Data analyses

Scale structure, reliability, and discriminant validity evidence. The three factor ESEM model was re-tested² to assess the degree to

² Similar to Study 2, we re-tested all other factor models. Yet again, a model with acceptable fit for the nine coach interpersonal behaviors (Model 3) was rejected on the basis of lack of sufficient items per factor. The three-factor CFA

which the factorial structure held when examined with a new sample of athletes. Similar to Study 2, model-to-data fit was determined using a multi-faceted approach. Raykov's composite reliability coefficient was used as an estimate of internal consistency. An examination of the factor correlations between the three subscales served as evidence for discriminant validity.

Structural equation modeling (SEM). We first estimated a six-factor model (three dimensions of coach interpersonal behaviors and three athlete outcomes) using a structural equation modeling (SEM) framework to explore the relations between the contextual and outcome variables. Subsequently, we tested a 12-factor model (three dimensions of coach interpersonal behaviors, six dimensions of athlete need satisfaction and frustration, and three athlete outcomes) using SEM to examine the relations between the contextual variables and need states. Yet again, a multi-faceted approach informed the assessment of model-to-data fit, with the same cut-off criteria described in Study 2. TMIB-C subscales were specified using the three-factor ESEM framework. As the test of an ESEM factor structure resulted in a negative residual variance for an item of the BPNSFS, its subscales were specified as six CFA factors. Athlete outcomes were individual subscales from measures of athlete engagement, burnout, and cognitive interference, and were, hence, estimated as single-factor CFAs each. Items were used as factor indicators. All analyses were conducted in Mplus 8.0.

9. Results and discussion

Prior to the main analyses, data were screened for normality. Median values for skewness and kurtosis were 1.175 (range -1.86 to 4.04) and 2.115 (range 0.04–17.72) respectively. All analyses were conducted using MLR.

9.1. Scale structure, reliability and discriminant validity evidence

The three-factor ESEM model was found to demonstrate good fit to the data [$\chi^2(168) = 281.747$, $p < .001$, CFI = 0.95, TLI = 0.93, RMSEA = 0.04 (90% CI 0.03 - 0.05), SRMR = 0.03]. Standardized factor loadings were significant and ranged between 0.40 and 0.94. One item of the need indifference subscale (“My coach is unresponsive to my opinions”) demonstrated a significant cross-loading of 0.24 on the need thwarting factor. However, as this value was smaller than its factor loading on its intended subscale (0.40), along with it conceptually being better representative of need indifference, we retained this item. Factor correlations between need thwarting and need supportive behaviors, need supportive and need indifferent behaviors, and between need thwarting and need indifferent behaviors were -0.67, -0.58, and 0.53, respectively. Estimates of internal consistency were acceptable (0.77 - 0.88) for all three subscales. Standard factor loadings, cross-loadings, item means, standard deviations, skewness, kurtosis, factor correlations, and internal consistency estimates are reported in [Table 6](#).

9.2. SEM

First, we conducted a correlational analysis to explore the associations between the three subscales of the TMIB-C, six subscales of the BPNSFS, and athlete outcomes (see [Table 7](#)). We then examined the

(footnote continued)

(Model 1) demonstrated good model to data fit, however, factor correlations were higher than those for the three-factor ESEM model. Most of the other models (e.g., Models 4, 6, 7, 8, 9, 10, 11) did not converge. Model 12 (bifactor one-G, three-S) also demonstrated good model-to-data fit, however, yet again, the S-factor for need thwarting was problematic, with only two items that had significant intended factor loadings.

Table 6
Factor Loadings, Standard Errors, Means, SDs, Kurtosis and Skewness for the TMIB-C Items (Study3).

Items	Factor loadings			SE	Means	SD	Skewness	Kurtosis
	NS	NT	NI					
<i>STEM: My coach ...</i>								
Shows that he/she understands my perspective	.66**			.09	5.49	1.20	-.97	.96
Ensures that tasks are suited to my skill level	.74**			.07	5.70	1.29	-1.22	1.53
Takes interest in my welfare	.79**			.08	5.82	1.23	-1.35	2.35
Encourages me to take my own initiative	.65**			.10	5.91	1.12	-1.42	2.66
Recognizes my efforts and accomplishments	.79**			.09	5.92	1.17	-1.42	2.57
Accepts me	.69**			.09	6.31	1.00	-1.86	4.19
Explains the reasons when he/she asks me to do something	.49**			.08	5.75	1.32	-1.39	1.71
Shows care and concern	.69**			.08	6.01	1.18	-1.38	1.88
Tries to control everything I do		.50**		.13	2.18	1.48	1.27	.69
Makes it clear that I have little to contribute		.49**		.10	1.75	1.39	2.21	4.29
Deliberately ignores me		.77**		.09	1.45	1.14	3.25	10.65
Dismisses my opinion		.65**		.09	1.59	1.18	2.39	5.58
Blames me when things don't go well		.67**		.08	1.73	1.34	2.14	3.99
Makes it clear that he/she doesn't like me		.94**		.07	1.29	.92	4.04	17.72
Uses guilt tactics to control what I do		.80**		.09	1.47	1.06	2.84	8.20
Belittles my abilities		.72**		.08	1.54	1.19	2.66	6.99
Is unresponsive to my opinions			.40**	.08	2.17	1.39	1.24	.87
Sets activities that aren't challenging enough			.75**	.08	2.52	1.53	1.01	.27
Keeps to himself/herself			.61**	.09	2.23	1.45	1.23	.86
Sets activities that lack variety			.71**	.07	2.52	1.55	.96	.04
Can be disorganized			.58**	.08	2.30	1.50	1.20	.66
Is indifferent to how I feel			.52**	.08	2.25	1.38	1.15	.83
Factor Correlations and Internal Consistency								
	1	2	3					
Need Thwarting	.88							
Need Support	-.67**	.88						
Need Indifference	.53**	-.58**	.77					

Note. ***p* < .001; **p* < .005. Target loadings are in bold. For clarity purposes, only cross-loadings over 0.20 are reported. NS = need supportive behaviors, NT = need thwarting behaviors, NI = need indifferent behaviors. Raykov's composite reliability coefficients are presented on the diagonal of the correlation matrix.

Table 7
Correlational Analysis for Subscales/Measures Included in Study 3.

	1	2	3	4	5	6	7	8	9	10	11	12
1 NT	–	-.64**	.52**	-.45**	.59**	-.27**	.41**	-.26**	.43**	-.27**	.43**	.43**
2 NS	-.64**	–	-.56**	.50**	-.45**	.38**	-.35**	.37**	-.37**	.36**	-.32**	-.38**
3 NI	.52**	-.56**	–	-.37**	.44**	-.25**	.34**	-.33**	.46**	-.25**	.38**	.50**
4 AS	-.45**	.50**	-.37**	–	-.57**	.52**	-.41**	.49**	-.42**	.44**	-.37**	-.37**
5 AF	.59**	-.45**	.44**	-.57**	–	-.37**	.57**	-.34**	.51**	-.28**	.59**	.53**
6 CS	-.27**	.38**	-.25**	.52**	-.37**	–	-.56**	.50**	-.35**	.46**	-.32**	-.27**
7 CF	.41**	-.35**	.34**	-.41**	.57**	-.56**	–	-.32**	.44**	-.25**	.50**	.45**
8 RS	-.26**	.37**	-.33**	.49**	-.34**	.50**	-.32**	–	-.67**	.39**	-.32**	-.30**
9 RF	.43**	-.37**	.46**	-.42**	.51**	-.35**	.44**	-.67**	–	-.35**	.37**	.47**
10 DED	-.27**	.36**	-.25**	.44**	-.28**	.46**	-.25**	.39**	-.35**	–	-.21**	-.34**
11 EX	.43**	-.32**	.38**	-.37**	.59**	-.32**	.50**	-.32**	.37**	-.21**	–	.49**
12 IT	.43**	-.38**	.50**	-.37**	.53**	-.27**	.45**	-.30**	.47**	-.34**	.49**	–

Note. NT = need thwarting, NS = need supportive, NI = need indifference, AS = autonomy satisfaction, AF = autonomy frustration, CS = competence satisfaction, CF = competence frustration, RS = relatedness satisfaction, RF = relatedness frustration, DED = dedication, EX = exhaustion, IT = irrelevant thoughts. ** Correlation is significant at the 0.01 level (two tailed).

relations between the three broad interpersonal behaviors and three athlete outcomes. Model fit was acceptable [χ^2 (541) = 881.96, *p* < .001, CFI = 0.95, TLI = 0.94, RMSEA = 0.04 (90% CI 0.04 - 0.05), SRMR = 0.04]. Significant standardized path coefficients for the structural portion of the model are reported in Figure 1. As expected, perceived need support predicted dedication, and perceived need thwarting predicted exhaustion. Also, as expected, need indifference was the only significant predictor of irrelevant thoughts. Surprisingly, it was also as good a predictor of exhaustion, as need thwarting was.

Subsequently, we entered all 12 factors into a SEM. The full model with three contextual factors, six needs factors, and three athlete outcomes demonstrated acceptable fit [χ^2 (1615) = 2749.12, *p* < .001, CFI = 0.90, TLI = 0.90, RMSEA = 0.04 (90% CI 0.04 - 0.05),

SRMR = 0.06]. Significant standardized path coefficients for the structural portion of the model are reported in Figure 2.

We focused our description on the paths between the interpersonal behaviors and the psychological needs, as the relations between the needs and the outcomes are irrelevant for the purposes of our study. As hypothesized, perceived need support predicted the satisfaction of all three needs in a significant manner. In contrast, perceived need thwarting predicted the frustration of all three needs. Perceived need indifference predicted autonomy frustration and competence frustration, but not as strongly as need thwarting did. Contrary to what was hypothesized, perceived need indifference predicted relatedness frustration better than perceived need thwarting.

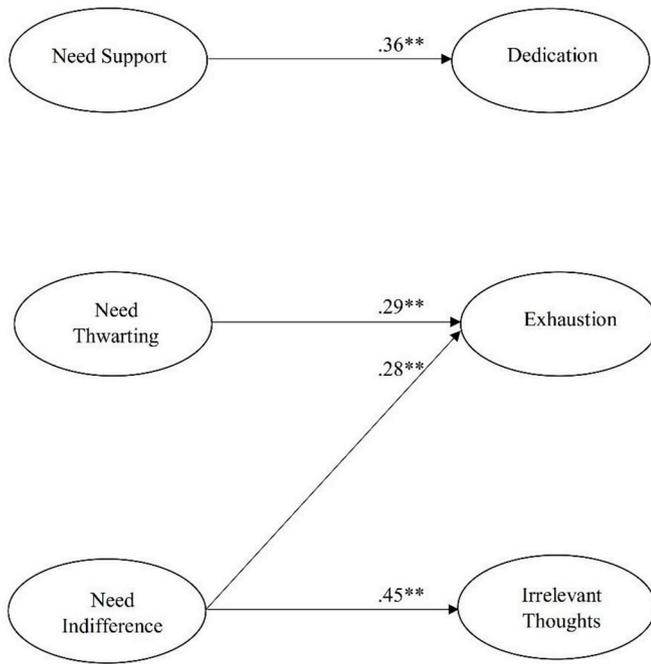


Fig. 1. SEM with need supportive, thwarting, and indifferent interpersonal behaviors, and dedication, exhaustion, and irrelevant thoughts. Note. ** $p < .01$. Only significant structural paths are reported for simplicity purposes.

10. General Discussion

In this three-study paper, we made a case for coach indifferent behaviors and presented the a) conceptual rationale for, b) development of, and c) initial validity evidence for a new SDT-based measure assessing athletes’ perceptions of their coaches’ need supportive,

thwarting, and indifferent interpersonal behaviors. These studies provide preliminary evidence regarding the dimensionality, reliability, discriminant validity of the TMIB-C, and nomological network of constructs surrounding its subscales.

11. Factorial validity evidence

In our assessment of the factorial structure of the TMIB-C, we found that solutions pertaining to modeling of support, thwarting, and indifference, independently for each of the three needs, were not supported. Instead, we found support for a three-factor solution consisting of the overarching coaching behaviors of need support, need thwarting, and need indifference, within which there was a relative balance of need-specific behaviors.

This finding is not surprising, as the sub-dimensions of need support have been conceptualized as interrelated (Ryan, 1991), and moderately strong correlations have been observed among them previously (Niemic et al., 2006). The scale development literature is also rife with examples of researchers adopting a unidimensional approach and combining autonomy, competence, and relatedness supports into a single factor of need support in settings such as health care (Williams et al., 1996), exercise (Markland & Tobin, 2010), medical education (Gucciardi et al., in press), and work (Tafvelin & Stenling, 2018). In the context of sport, Stenling, Ivarsson, Hassmen, and Lindwall (2015) recently re-examined the dimensionality of the ISS-C (Wilson et al., 2009), and showed that the items of this measure are best represented by the general dimension of need support, instead of need specific sub-dimensions. Our unidimensional approach is also in line with recent SDT reviews (e.g., Deci, Olafsen, & Ryan, 2017), which bear references to overall “need supportive” and “need thwarting” environments, without often referring to need-specific dimensions.

At the level of the personal experience of the needs, Proposition IV within the Basic Psychological Needs Theory (BPNT) of SDT states that “Basic need satisfactions of autonomy, competence, and relatedness will tend to positively relate to one another, especially at an aggregated level of analysis (i.e., across domains, situations, or time)” (Ryan &

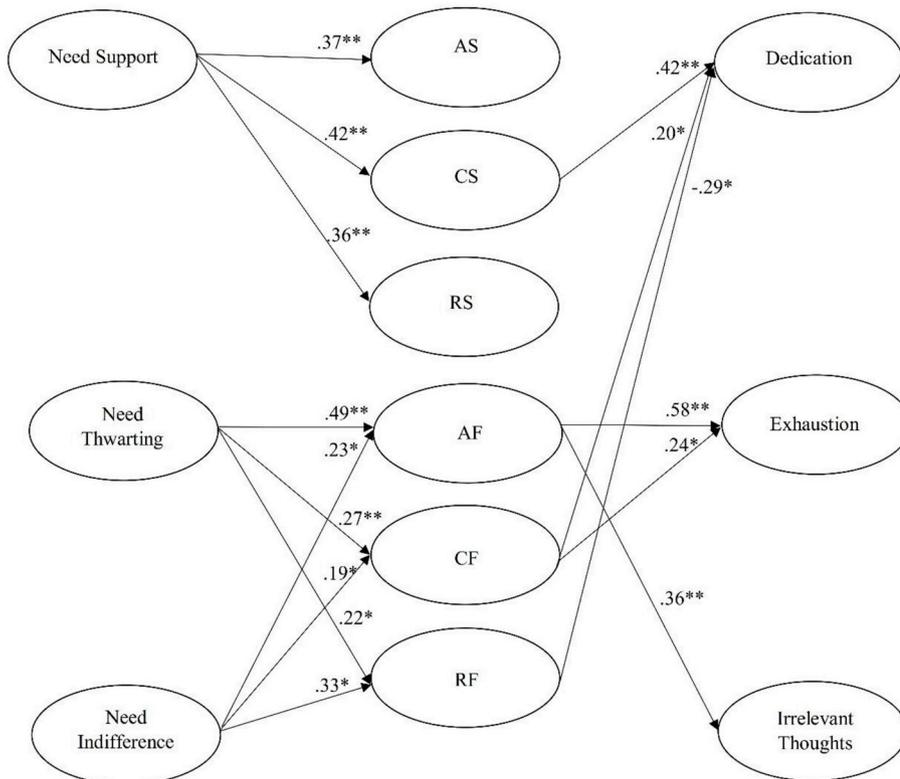


Fig. 2. SEM with need supportive, thwarting, and indifferent interpersonal behaviors, six dimensions of the need states, dedication, exhaustion, and irrelevant thoughts. Note. ** $p < .01$, * $p < .05$. AS = autonomy satisfaction; CS = competence satisfaction; RS = relatedness satisfaction; AF = autonomy frustration; CF = competence frustration; RF = relatedness frustration. Only significant structural paths are reported for simplicity purposes.

Deci, 2017, p. 249). That is, although the three needs are distinct in terms of their conceptualizations, they are empirically interrelated. The satisfaction/frustration of one need will often result in the satisfaction/frustration of the others, and high correlations are more likely when these experiences are examined in a cumulative manner within a given context, or collapsed over time. In terms of scale development efforts, instead of attempting to impose factorial structures where the needs are estimated to be orthogonal, Ryan and Deci (2017) urge researchers to bear in mind these associations between the needs, and observe “what the data tell us - namely, that these three basic needs, in the natural scheme of wellness, operate convergently. This is, after all, why all three are considered basic” (p. 249).

Such patterns of interrelatedness between the needs would also be expected to extend to the social environment, such that behaviors that are perceived to be supportive of one need are also likely to be perceived as supportive of the others. For example, encouraging athletes to take their own initiatives is considered to be an important behavior in supporting their need for autonomy. Athletes might also perceive this as a behavior that supports their need for competence (e.g., “my coach recognizes my efforts and accomplishments, and hence encourages me to take my own initiative”), as well as relatedness (e.g., “my coach likes me, and therefore encourages me to take my own initiative”).

Although we do not dismiss the potential utility of measuring need-specific coaching behaviors (particularly in experiments with factorial designs that aim to isolate their independent effects or in field interventions), we believe that such a parsimonious representation of the social environment is in line with theory and has practical utility in examining the role of supportive, thwarting or indifferent social environments alongside other variables in studies testing nomological networks (e.g., contextual variables, psychological need states, motivation regulations, and indices of athlete cognition, behavior, and affect).

We also sought to ascertain whether need indifferent behaviors could be operationally distinguished from need supportive and thwarting behaviors. In Study 1 and Study 2, we found moderate-sized correlations between need thwarting and need indifference ($r = 0.62$, and $r = 0.53$, respectively), and need support and need indifference ($r = -0.67$, and $r = -0.58$, respectively). These are factor correlations, which are not attenuated by measurement error, hence, they are larger than Pearson’s correlations. In sum, the results from the tests of factorial structure substantiate our proposition for the consideration of the third category of need indifferent interpersonal behaviors.

11.1. Evidence for nomological network

In terms of the relations between interpersonal behaviors and athlete outcomes, athletes who perceived that their coaches used a high level of need supportive strategies were more likely to report dedication to their sport. Athletes will potentially want to devote more time and energy to pursue their sport-relevant objectives if they perceive their coaches are able to provide them with personally relevant choices, genuinely appreciate the effort and hard work they put into training, and accept them in an unconditional manner. Dedication has previously been examined as a part of athlete engagement (Lonsdale et al., 2007); perceived coach interpersonal behaviors have been found to correlate with athlete engagement (Curran, Hill, Hall, & Jowett, 2014; Curran, Hill, Ntoumanis, Hall, & Jowett, 2016).

We also found that athletes who perceived their coaches as need thwarting were more likely to report emotional and physical exhaustion in their sport. Experiencing active dislike, disparaging critique, and excessive control from the coach in an environment that is already physically and emotionally taxing, would potentially put athletes at risk of feeling fatigued. Exhaustion has been conceptualized to be a core dimension of athlete burnout (Gustafsson, Kenttä, & Hassmén, 2011), and researchers have previously found coach interpersonal behaviors to be associated with athlete burnout (e.g., Barcza-Renner, Eklund, Morin,

& Habeeb, 2016).

Finally, athletes who perceived their coaches as need indifferent were likely to report sport irrelevant thoughts. On experiencing different interpersonal behaviors consisting of the coach being aloof, disorganized, or impassive to their opinions, athletes may come to be aware of the disconnection between their psychological needs and the activity at hand. Thus, they might (cognitively and/or behaviorally) disengage from it, and instead engage in other activities that may potentially be more relevant to their needs (for example, thinking about friends). Unexpectedly, we also found that need indifferent coaching predicted feelings of exhaustion. Perhaps on experiencing such coaching behaviors, athletes may also be convinced that they have been left on their own accord, and need to take charge of their own training. Athletes without appropriate guidance from the coach may resort to training inappropriately, overtraining, or not resting sufficiently, thus potentially predisposing themselves to exhaustion.

With regards to the relations between coaches’ interpersonal behaviors and athletes’ need states, in line with our expectations and findings of previous research (e.g., Pulido et al., 2018; Rocchi et al., 2017), athletes who perceived their coaches as need supportive were more likely to report autonomy, competence, and relatedness need satisfaction. Athletes who perceived their coaches to be need thwarting were more likely to experience autonomy, competence, and relatedness need frustration. Athletes who perceived their coaches to be need indifferent were also likely to experience autonomy and competence need frustration, but to a lesser extent as compared to perceived need thwarting coaching.

An unexpected finding was that perceived need indifference predicted relatedness frustration slightly better than perceived need thwarting. This finding might be due to the nature of some of the items of the relatedness frustration subscale of the BPNSFS (Chen et al., 2015). Instead of capturing the experiential state resulting from experiencing a need thwarting behaviors, two of the four items of this subscale assess athletes’ need states that might be a result of experiencing indifferent interpersonal behaviors from others (e.g., “I feel that people who are important to me are cold and distant towards me” and “I feel the relationships I have are just superficial”).

In sum, in terms of evidence of nomological networks, our findings were somewhat mixed. As expected, need indifference was a weaker predictor of autonomy and competence need frustration, and the sole significant predictor of irrelevant thoughts, however, unexpectedly, need indifference was as good as or better predictor than need thwarting was of exhaustion and relatedness need frustration, respectively.

11.2. Limitations, future directions, and conclusions

Although the findings from these three studies provide initial evidence supporting the suitability of the TMIB-C for the sport domain, the results should be considered in light of some limitations. First, the cross-sectional nature of these studies means that causal directions of the examined associations cannot be ascertained. Experimental designs adopting a factorial approach could aim to test the independent causal effects of the TMIB-C factors. Further, longitudinal examinations at multiple time-points (for example, over the course of a sport season) could aid the understanding of the fluctuation of these coaching behaviors over time. Another limitation of our work was that tests of nomological networks utilized self-report outcomes only; future research could include biological markers of well/ill-being (e.g., Qusted et al., 2011).

Ideographic methods (e.g., “think aloud” protocols) with athletes could provide valuable insights into what criteria they use to distinguish perceptions of need indifference from those of need support, and need thwarting, and the stability of such criteria under different contexts and time periods. The identification of a third class of coaching behaviors could help provide more targeted intervention approaches to

reduce their occurrence. Future research could also examine the antecedents of coach interpersonal behaviors. Examinations of the differential antecedents of the three behaviors may help provide insight into what drives coaches to adopt such behaviors. For example, Cheon et al. (2019) posited that social agents adopt indifferent interpersonal behaviors because they are more attentive to their own needs and goals over those of others. In addition, it would be interesting to examine if different analytical methods such as multidimensional scaling (e.g., Tucker-Drob & Salthouse, 2009), and item response theory (e.g., Courvoisier & Etter, 2008) might be more appropriate to capture the multi-faceted nature of the need-specific coaching behaviors. Lastly, researchers could test the applicability of the items (or slight modifications of them) as well as the replication of our results in other domains such as healthcare, work, and education. We hope this tripartite conceptualization and measurement can further advance conceptual understanding and intervention efforts on interpersonal behaviors in sport and potentially other life domains.

Funding

This research was supported by a Curtin International Postgraduate Research Scholarship; Faculty of Health Sciences Scholarship; Curtin University of Technology.

Declarations of interest

None.

Author declaration

Declarations of interest

Prof. Nikos Ntoumanis is one of the Editors-in-Chief of PSE. However, he had no involvement in any aspect of the review process for this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.psychsport.2019.05.006>.

References

- Adie, J., 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*, 189–199. doi: 10.1016/j.psychsport.2011.07.008.
- Adie, J., 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*, 51–59. <https://doi.org/10.1016/j.psychsport.2011.07.008>.
- Aelterman, N., Vansteenkiste, M., Soenens, B., Fontaine, J., Haerens, L., & Reeve, J. (2018). Towards a fine-grained understanding of need-supportive and need-thwarting teaching: The merits of a gradual approach. *Journal of Educational Psychology*. Advance online publication. <https://doi.org/10.1037/edu0000293>.
- American Educational Research Association (AERA), American Psychological Association (APA), & National Council on Measurement in Education (NCME) (2014). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.
- 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*, 654–670. <https://doi.org/10.1016/j.psychsport.2006.11.003>.
- Asparouhov, T., & Muthén, B. (2009). Exploratory structural equation modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *16*, 397–438. <https://doi.org/10.1080/10705510903008204>.
- Bandalos, D. L. (2014). Relative performance of categorical diagonally weighted least squares and robust maximum likelihood estimation. *Structural Equation Modeling*, *21*, 102–116. <https://doi.org/10.1080/10705511.2014.859510>.
- Barcza-Renner, K., Eklund, R. C., Morin, A. J., & Habeeb, C. M. (2016). Controlling coaching behaviors and athlete burnout: Investigating the mediating roles of perfectionism and motivation. *Journal of Sport & Exercise Psychology*, *38*, 30–44. <https://doi.org/10.1123/jsep.2015-0059>.
- Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin*, *37*, 1459–1473. <https://doi.org/10.1123/jsep.32.2.193>.
- Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2010). The controlling interpersonal style in a coaching context: Development and initial validation of a psychometric scale. *Journal of Sport & Exercise Psychology*, *32*, 193–216. <https://doi.org/10.1177/0146167211413125>.
- Brown, T. A. (2015). *Methodology in the social sciences. Confirmatory factor analysis for applied research* (2nd ed.). New York, NY, US: Guilford Press.
- Browne, M. (2001). An overview of analytic rotation in exploratory factor analysis. *Multivariate Behavioral Research*, *36*, 111–150. https://doi.org/10.1207/S15327906MBR3601_05.
- Cain, M. K., Zhang, Z., & Yuan, K.-H. (2017). Univariate and multivariate skewness and kurtosis for measuring nonnormality: Prevalence, influence and estimation. *Behavior Research Methods*, *49*, 1716–1735. <https://doi.org/10.3758/s13428-016-0814-1>.
- Chen, F. F., Hayes, A., Carver, C. S., Laurenceau, J. P., & Zhang, Z. (2012). Modeling general and specific variance in multifaceted constructs: A comparison of the bifactor model to other approaches. *Journal of Personality*, *80*, 219–251. <https://doi.org/10.1111/j.1467-6494.2011.00739.x>.
- Chen, B., Mouratidis, A., Ryan, R. M., Sheldon, K. M., Soenens, B., Van Petegem, S., Verstuyf, J., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., Duriez, B., Lens, W., & Matos, L. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, *39*, 216–236. <https://doi.org/10.1007/s11031-014-9450-1>.
- 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*, 1–11. <https://doi.org/10.1016/j.psychsport.2015.02.007>.
- Cheon, S. H., Reeve, J., Lee, Y., Ntoumanis, N., Gillet, N., Kim, B. R., & Song, Y.-G. (2019). Expanding autonomy psychological need states from two (satisfaction, frustration) to three (dissatisfaction): A classroom-based intervention study. *Journal of Educational Psychology*, *111*, 685–702. <https://doi.org/10.1037/edu0000306>.
- Clark, L. A., & Watson, D. (2019). *Constructing validity: New developments in creating objective measuring instruments*. Psychological assessment. Advance online publication <https://doi.org/10.1037/pas0000626>.
- Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis*. Hillsdale, NJ: Erlbaum.
- Courvoisier, D., & Etter, J.-F. (2008). Using item response theory to study the convergent and discriminant validity of three questionnaires measuring cigarette dependence. *Psychology of Addictive Behaviors*, *22*, 391–401. <https://doi.org/10.1037/0893-164X.22.3.391>.
- 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*, 559–580. <https://doi.org/10.7352/IJSP2014.45.559>.
- Curran, T., Hill, A. P., & Niemiec, C. P. (2013). A conditional process model of children's behavioral engagement and behavioral disaffection in sport based on self-determination theory. *Journal of Sport & Exercise Psychology*, *35*, 30–43. <https://doi.org/10.1123/jsep.35.1.30>.
- Curran, T., Hill, A. P., Ntoumanis, N., Hall, H. K., & Jowett, G. E. (2016). A three-wave longitudinal test of self-determination theory's mediation model of engagement and disaffection in youth sport. *Journal of Sport & Exercise Psychology*, *38*, 15–29. <https://doi.org/10.1123/jsep.2015-0016>.
- Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*, 19–43. <https://doi.org/10.1146/annurev-orgpsych-032516-113108>.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- Delrue, J., Reynders, B., Vande Broek, G., Aelterman, N., De Backer, M., Decroos, S., De Muynck, G.-J., Fontaine, J., Franssen, K., van Puyenbroeck, S., Haerens, L., & Vansteenkiste, M. (2019). Adopting a helicopter-perspective towards motivating and demotivating coaching: A circumplex approach. *Psychology of Sport and Exercise*, *40*, 110–126. <https://doi.org/10.1016/j.psychsport.2018.08.008>.
- DeVellis, R. F. (2012). *Scale development: Theory and applications* (3rd ed.). Thousand Oaks, CA: SAGE.
- Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence: A social contextual perspective. *Journal of Educational Psychology*, *81*, 143–154. <https://doi.org/10.1037/0022-0663.81.2.143>.
- Gucciarini, D. F., Weixian, J. C., Gibson, W., Ntoumanis, N., & Ng, L. (in press). Motivational climate in the classroom: Factorial and convergent validity evidence of the Need Support Behaviours Scale with health science students. *European Journal of Psychological Assessment* doi: 10.1027/1015-5759/a000524.
- Gustafsson, H., Kenttä, G., & Hassmén, P. (2011). Athlete burnout: An integrated model and future research directions. *International Review of Sport and Exercise Psychology*, *4*, 3–24. <https://doi.org/10.1080/1750984X.2010.541927>.
- Haerens, L., Vansteenkiste, M., De Meester, A., Delrue, J., Tallir, I., Vande Broek, G., Goris, W., & Aelterman, N. (2018). Different combinations of perceived autonomy support and control: Identifying the most optimal motivating style. *Physical Education and Sport Pedagogy*, *23*, 16–36. <https://doi.org/10.1080/17408989.2017.1346070>.
- Hancox, J. E., Qusted, E., Thøgersen-Ntoumani, C., & Ntoumanis, N. (2015). An intervention to train group exercise class instructors to adopt a motivationally adaptive communication style: A quasi-experimental study protocol. *Health Psychology and Behavioral Medicine*, *3*, 190–203. <https://doi.org/10.1080/21642850.2015.1074075>.
- Hatzigeorgiadis, A., & Biddle, S. J. H. (2001). Athletes' perceptions of how cognitive inter-

- ference during competition influences concentration and effort. *Anxiety, Stress & Coping*, 14, 411–429. <https://doi.org/10.1080/10615800108248364>.
- Holzinger, K. J., & Swineford, S. (1937). The bifactor method. *Psychometrika*, 2, 41–54. <https://doi.org/10.1123/psp.23.2.186>.
- Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, 6, 53–60.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55. <https://doi.org/10.1080/10705519909540118>.
- Hurley, A., Scandura, T., Schriesheim, C., Brannick, M., Seers, A., Vandenberg, R., & Williams, L. (1997). Exploratory and confirmatory factor analysis: Guidelines, issues, and alternatives. *Journal of Organizational Behaviour*, 18, 667–683. [https://doi.org/10.1002/\(SICI\)1099-1379\(199711\)18:6<667::AID-JOB874>3.0.CO;2-T](https://doi.org/10.1002/(SICI)1099-1379(199711)18:6<667::AID-JOB874>3.0.CO;2-T).
- John, O., & Benet-Martínez, V. (2000). Measurement: Reliability, construct validation, and scale construction. In H. T. Reis, & C. M. Judd (Eds.). *Handbook of research methods in social and personality psychology* (pp. 339–369). Cambridge University Press.
- Katz, I., & Assor, A. (2007). When choice motivates and when it does not. *Educational Psychology Review*, 19, 429–442. <https://doi.org/10.1007/s10648-006-9027-y>.
- Kinnafick, F. E., Thøgersen-Ntoumani, C., & Duda, J. (2016). The effect of need supportive text messages on motivation and physical activity behaviour. *Journal of Behaviour Medicine*, 39, 574–586. <https://doi.org/10.1007/s10865-016-9722-1>.
- Lonsdale, C., Hodge, K., & Jackson, S. (2007). Athlete engagement: II. Development and initial validation of the athlete engagement questionnaire. *International Journal of Sport Psychology*, 38, 471–492. <https://doi.org/10.1037/t50268-000>.
- Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35, 382–385.
- Mageau, G. A., & Vallerand, R. J. (2003). The coach–athlete relationship: A motivational model. *Journal of Sports Sciences*, 21, 883–904. <https://doi.org/10.1080/0264041031000140374>.
- Markland, D., & Tobin, V. J. (2010). Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychology of Sport and Exercise*, 11, 91–99. <https://doi.org/10.1016/j.psychsport.2009.07.001>.
- Marsh, H. W., Hau, K.-T., & Grayson, D. (2005). Goodness of fit evaluation in structural equation modeling. In A. Maydeu-Olivares, & J. McArdle (Eds.). *Psychometrics: A festschrift for roderick P. McDonald* (pp. 275–340). Hillsdale, NJ: Erlbaum.
- Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to cutoff values for fit indexes and dangers in over-generalizing Hu & Bentler (1999). *Structural Equation Modeling*, 11, 320–341. https://doi.org/10.1207/s15328007sem1103_2.
- Masser, M., & Creed, L. (1976). *The greatest love of all* [Recorded by Whitney Houston]. USA: Arista: On Whitney Houston [CD].
- 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: From theory to practice* (pp. 145–180). San Diego, CA, US: Elsevier Academic Press. <https://doi.org/10.1016/B978-0-12-803634-1.00007-8>.
- Morin, A. J. S., Arens, A. K., & Marsh, H. W. (2016). A bifactor exploratory structural equation modeling framework for the identification of distinct sources of construct-relevant psychometric multidimensionality. *Structural Equation Modeling*, 23, 116–129. <https://doi.org/10.1080/10705511.2014.961800>.
- Muthén, L., & Muthén, B. (1998–2017). *Mplus user's guide* (8th ed.). Los Angeles, CA: Muthén & Muthén.
- Niemiec, C., Lynch, M., Vansteenkiste, M., Bernstein, J., Deci, E., & Ryan, R. (2006). The antecedents and consequences of autonomous self-regulation for college: A self-determination theory perspective on socialization. *Journal of Adolescence*, 29, 761–775. <https://doi.org/10.1016/j.adolescence.2005.11.009>.
- Ntoumanis, N., & Mallett, C. (2014). Motivation in sport: A self-determination theory perspective. In A. Papaioannou, & D. Hackfort (Eds.). *Routledge companion to sport and exercise psychology: Global perspectives and fundamental concepts* (pp. 67–82). Taylor and Francis.
- Ntoumanis, N., Quested, E., Reeve, J., & Cheon, S. H. (2018). Need supportive communication: Implications for motivation in sport, exercise, and physical activity. In B. Jackson, J. A. Dimmock, & J. Compton (Eds.). *Persuasion and communication in sport, exercise, and physical activity* (pp. 155–169). Abingdon, UK: Routledge.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York, NY: McGraw-Hill.
- Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Brière, N. M. (2001). Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion*, 25, 279–306. <https://doi.org/10.1023/A:1014805132406>.
- Politt, E. F., Beck, T. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health*, 30, 459–467. <https://doi.org/10.1002/nur.20199>.
- Pulido, J. J., Sánchez-Oliva, D., Leo, F. M., Sánchez-Cano, J., & García-Calvo, T. (2018). Development and validation of coaches' interpersonal style questionnaire. *Measurement in Physical Education and Exercise Science*, 22, 25–37. <https://doi.org/10.1080/1091367X.2017.1369982>.
- Quested, E., Bosch, J. A., Burns, V. E., Cumming, J., Ntoumanis, N., & Duda, J. L. (2011). Basic psychological need satisfaction, stress-related appraisals, and dancers' cortisol and anxiety responses. *Journal of Sport & Exercise Psychology*, 33, 828–846. <https://doi.org/10.1123/jsep.33.6.828>.
- Quested, E., Ntoumanis, N., Stenling, A., Thøgersen-Ntoumani, C., & Hancox, J. E. (2018). The need-relevant instructor behaviours scale (NIBS): Development and initial validation. *Journal of Sport & Exercise Psychology*, 40, 259–268. <https://doi.org/10.1123/jsep.2018-0043>.
- Raedeke, T. D., & Smith, A. L. (2001). Development and preliminary validation of an athlete burnout measure. *Journal of Sport & Exercise Psychology*, 23, 281–306. <https://doi.org/10.1123/jsep.23.4.281>.
- Ramis, Y., Torregrosa, M., Viladrich, C., & Cruz, J. (2017). The effect of coaches' controlling style on the competitive anxiety of young athletes. *Frontiers in Psychology*, 8, 572. <https://doi.org/10.3389/fpsyg.2017.00572>.
- Raykov, T. (1997). Estimation of composite reliability for congeneric measures. *Applied Psychological Measurement*, 21, 173–184. <https://doi.org/10.1177/01466216970212006>.
- Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. *The Elementary School Journal*, 106, 225–236. <https://doi.org/10.1086/501484>.
- Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, 37(44), 159–175. <https://doi.org/10.1080/00461520903028990>.
- Reise, S. P. (2012). Invited paper: The rediscovery of bifactor measurement models. *Multivariate Behavioral Research*, 47, 667–696. <https://doi.org/10.1080/00273171.2012.715555>.
- Rhemtulla, M., Brossseau-Laird, P. E., & Savalei, V. (2012). When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation methods under suboptimal conditions. *Psychological Methods*, 17, 354–373. <https://doi.org/10.1037/a0029315>.
- Rocchi, M., Pelletier, L., & Desmarais, P. (2017). The validity of the interpersonal behaviours questionnaire (IBQ) in sport. *Measurement in Physical Education and Exercise Science*, 21, 15–25. <https://doi.org/10.1080/1091367X.2016.1242488>.
- Ryan, R. M. (1991). The nature of the self in autonomy and relatedness. In J. Strauss, & G. R. Goethals (Eds.). *The self: Interdisciplinary approaches* (pp. 208–238). New York, NY: Springer. https://doi.org/10.1007/978-1-4684-8264-5_11.
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory. Basic psychological needs in motivation, development and wellness*. New York, NY: Guilford Press.
- Sheldon, K. M., & Filak, V. (2008). Manipulating autonomy, competence and relatedness support in a game-learning context: New evidence that all three needs matter. *British Journal of Social Psychology*, 47, 267–283. <https://doi.org/10.1348/014466607X238797>.
- Skinner, E. L., Johnson, S., & Snyder, T. (2005). Six dimensions of parenting: A motivational model. *Parenting: Science and Practice*, 5, 175–235. https://doi.org/10.1207/s15327922par0502_3.
- Skinner, E. A., Wellborn, J. G., & Regan, C. (1986). (Tech rep.) *The parents as social context questionnaire (PASCQ): Parent and child-reports of parent involvement, structure, and autonomy support*. Rochester, NY: University of Rochester.
- Smith, N., Quested, E., Appleton, P., & Duda, J. L. (2016). A review of observational instruments to assess the motivational environment in sport and physical education settings. *International Review of Sport and Exercise Psychology*, 134–159. <https://doi.org/10.1080/1750984X.2015.1132334>.
- Standage, M., Curran, T., & Rouse, P. (2019). Self-determination based theories of sport, exercise, and physical activity motivation. In T. S. Horn, & A. L. Smith (Eds.). *Advances in sport and exercise psychology* (pp. 289–311). (4th ed.). Champaign, U. S. A.: Human Kinetics.
- Stenling, A., Ivarsson, A., Hassmen, P., & Lindwall, M. (2015). Using bifactor exploratory structural equation modeling to examine global and specific factors in measures of sports coaches' interpersonal styles. *Frontiers in Psychology*, 6, 1–12. <https://doi.org/10.3389/fpsyg.2015.01303>.
- Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.
- Tafvelin, S., & Stenling, A. (2018). Development and initial validation of the need satisfaction and need support at work scales: A validity-focused approach. *Scandinavian Journal of Work and Organizational Psychology*, 3, 1–14. <https://doi.org/10.16993/sjwpow.30>.
- Tessier, D., Sarrazin, P., & Ntoumanis, N. (2008). The effect of an experimental program to support students' autonomy on the overt behaviours of physical education teachers. *European Journal of Psychology of Education*, 23, 239–253. <https://doi.org/10.1007/BF03172998>.
- Tucker-Drob, E. M., & Salthouse, T. A. (2009). Confirmatory factor analysis and multidimensional scaling for construct validation of cognitive abilities. *International Journal of Behavioral Development*, 33, 277–285. <https://doi.org/10.1177/0165025409104489>.
- Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. In T. C. Urdan, & S. A. Karabenick (Eds.). *Advances in motivation and achievement, v. 16A-The decade ahead: Theoretical perspectives on motivation and achievement* (pp. 105–165). London, England: Emerald Group Publishing Limited.
- Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, 23, 263–280. <https://doi.org/10.1037/a0032359>.
- Williams, G. C., Grow, V., M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, 70, 115–126. <https://doi.org/10.1037/0022-3514.70.1.115>.
- Wilson, P. M., Gregson, J. P., & Mack, D. E. (2009). The importance of interpersonal style in competitive sport: A self-determination theory approach. In C. H. Chang (Ed.). *Handbook of sport psychology* (pp. 259–276). Hauppauge, NY: Nova Science.