Original Article

Motivational Climate in the Classroom

Factorial and Convergent Validity Evidence of the Need-Supportive Behaviors Scale With Health Science Students

Daniel F. Gucciardi[1], Joseph Chen Weixian[1], William Gibson[2], Nikos Ntoumanis[3], and Leo Ng[1]

[1]School of Physiotherapy and Exercise Science, Curtin University, Perth, Australia
[2]School of Physiotherapy, The University of Notre Dame, Australia
[3]School of Psychology and Speech Pathology, Curtin University, Perth, Australia

Abstract: Adaptive motivation is central to positive functioning. Social agents such as teachers play a significant role in shaping the motivation of people with whom they interact by satisfying or thwarting their psychological needs of autonomy, competence, and relatedness. The development and validation of tools that assess the types of behaviors social agents adopt to satisfy these psychological needs are important agenda items for substantive and applied researchers. In this study, we examined factorial and convergent validity evidence of a need support scale adapted from the physical education context for use in tertiary settings with health science students. Factor analyses of responses from 290 health science students indicated that need-supportive behaviors are best captured by one latent factor, rather than the a priori 4-factor structure designed to capture needs for autonomy, relatedness, and competence. Regression analyses supported the convergent validity of the unidimensional structure, such that students who perceived higher levels of need-supportive behaviors from their tutor reported higher levels of behavioral engagement, and experiences of vitality and learning. Validation of a scale that assesses need-supportive behaviors within a health science context provides researchers with a tool to employ in future research that aims to investigate the antecedents and outcomes of such behaviors, as well as the effects of interventions designed to equip educators with the skills, motivation, and knowledge to employ successfully such behaviors.

Keywords: exploratory bifactor analysis, exploratory structural equation modeling, scale validation

Motivation, which encompasses people's reasons for initiating and sustaining behavior (Deci & Ryan, 2001), is central to positive or negative functioning (e.g., health, performance) in a range of contexts, including work (Moran, Diefendorff, Kim, & Liu, 2012), sports (Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010), education (Lemos & Veríssimo, 2014), and healthcare (Ng et al., 2012). Self-determination theorists (Deci & Ryan, 2000) distinguish between self-determined motivation (i.e., reflecting enjoyment and personal value), controlled motivation (i.e., reflecting internal or external pressures and contingencies), and amotivation (i.e., lack of intention and willingness to engage in a behavior). Between these two poles are four types of extrinsic motivations. In increasing magnitude of self-determination, these reflect behavioral engagement guided by tangible rewards or punishments (external regulation); internal rewards (e.g., pride) and sanctions (e.g., guilt) (introjected regulation); the value and benefits of the activity (identified regulation); and full assimilation of the activity with other important life goals (integrated regulation) (Deci & Ryan, 2000). Substantial research has shown that self-determined forms of motivation are associated with positive outcomes, including better academic performance, positive emotionality, improved creativity, better conceptual understanding, and improved wellbeing (Deci & Ryan, 2001; Lemos & Veríssimo, 2014; Levesque, Copeland, Pattie, & Deci, 2010; Reeve, Bolt, & Cai, 1999). Conversely, controlled forms of motivation and amotivation are usually linked to negative outcomes (e.g., school dropouts, burnout, poor health; Lemos & Veríssimo, 2014; Levesque et al., 2010; Liu, Wang, Tan, Koh, & Ee, 2009). Thus, in achievement-driven contexts like education, it is important that students are motivated for autonomous reasons.

Although it is most beneficial to possess autonomous motivation rather than controlled motivation (Ng et al., 2012), there are many occasions in life where people are presented with a task in which they have little or no

autonomous motivation to perform a behavior, and therefore engage in the task for reasons that are controlled in nature. For example, students who have little interest in studying may possess controlled motivation to do so (e.g., trying to pass the exams to avoid reprimands from family members). In these cases, it is important to convert people's controlled motivation into autonomous motivation through the process of internalization and integration, whereby individuals accept and adopt the reasons for performance of a task as their own (e.g., studying because they are interested in gaining more knowledge; Deci & Ryan, 2001; Levesque et al., 2010). Within the context of self-determination theory (SDT), the internalization of motivation can be achieved through the satisfaction of three basic psychological needs, namely, autonomy, competence, and relatedness (Deci & Ryan, 2000, 2001). Autonomy refers to individuals' propensity to self-organize their behavior and to act in accordance with their integrated self (Deci & Ryan, 2000). Competence characterizes the capacity to have an effect on the environment and to attain valued outcomes within it (Deci & Ryan, 2000). Relatedness is described as the desire to feel connected to others, be loved and cared (Deci & Ryan, 2000). Meta-analytic data indicate that satisfaction of these three psychological needs is positively associated with autonomous forms of motivation, physical and psychological health, and inversely related with controlled forms of motivation and amotivation (Ng et al., 2012).

Fostering Psychological Needs and Self-Determined Motivation via Need Supportive Interpersonal Communication

Numerous studies have linked the fulfillment of basic psychological needs to the interpersonal style of social agents (e.g., coaches, lecturers, healthcare providers; Amorose & Anderson-Butcher, 2007; Ng et al., 2012; Reeve et al., 2014; Rocchi, Pelletier, & Lauren Couture, 2013; Su & Reeve, 2011). Interpersonal styles can be broadly categorized (Bartholomew et al., 2010; Reeve et al., 2014) as need supportive (previously referred to in the self-determination theory literature as autonomy-supportive) or need thwarting (Ryan & Deci, 2017). Social agents who are need supportive provide the people with whom they interact opportunities to participate in decision making, acknowledge their feelings, minimize the amount of pressure placed on them, and offer meaningful choices for tasks or behaviors (Reeve et al., 2014; Rocchi et al., 2013). Social agents who are need thwarting use intimidation or excessive personal control, are cold and rejecting of others, and make them feel incompetent. Need supportive interpersonal styles are used by individuals in position of authority or expertise to satisfy the psychological needs of people with whom they interact, and therefore promote self-determined motivation and optimal behavioral, cognitive, and affective experiences (Ntoumanis, Quested, Reeve, & Cheon, 2018).

Assessing Need Supportive Behaviors in Health Education

Given the importance of need supportive behaviors for fostering optimal forms of motivation in others, there is a need for tools that permit the assessment of responses with sound reliability and validity evidence to maximize researchers' confidence in assessments of such behaviors among health educators in tertiary settings. Although a number of self-report scales have been developed to assess need-supportive behaviors, most research has utilized the Health Care Climate Questionnaire (Williams, Cox, Kouides, & Deci, 1999).[1] Given the predominance of autonomy supportive behaviors in this scale, there is a need for a tool in tertiary health education settings that adequately captures the content and breadth of all three psychological needs.

Research by Haerens et al. (2013) focused on developing an observation tool to measure the support of all three psychological needs within a physical education context (Haerens et al., 2013). In total, 74 physical education classes were observed and assessed at 5 min intervals for teachers' use of 21 different types of need-supportive behaviors. Exploratory factor analysis revealed four behavioral categories reflecting support for structure before and during the activity (both were sub-dimensions of competence support), relatedness, and autonomy (Haerens et al., 2013). Surprisingly, the two dimensions of structure were unrelated. Also, a number of cross-loadings emerged, indicating the need for additional testing of this scale.

Validity considerations regarding both the internal structure of a scale (e.g., factorial validity) and relations with external criteria (e.g., convergent validity) are important features of scale validation studies. This study focused on both aspects of validity. We garnered convergent validity evidence by assessing the degree to which the measure of need-supportive behaviors relates to students' behavioral engagement and thriving. Behavioral engagement

[1] It is worth noting the existence of other scales designed to assess perceptions of teachers' motivational or interpersonal styles, such as the Teacher as Social Context Questionnaire (Belmont, Skinner, Wellborn, & Connell, 1988), Student-Teacher Relationship Scale (Pianta, 1992), and the Learning Climate Questionnaire (Williams & Deci, 1996). As these scales are either based on other theoretical frameworks or earlier conceptualisations of the climate within the self-determination theory literature, we exclude a detailed discussion of these questionnaires.

encompasses students' effort, persistence, participation, and involvement in teaching-related tasks and activities (Archambault, Janosz, Fallu, & Pagani, 2009; Fredricks, Blumenfeld, & Paris, 2004). Individuals who perceive social agents as being need-supportive demonstrate higher levels of behavioral engagement (Stroet, Opdenakker, & Minnaert, 2013), which in turn is associated with higher achievement among students. Thriving is defined as a psychological state of growth and momentum that comprises both vitality (i.e. feeling alive and energetic) and learning (i.e. sense of continual improvement and increasing competence at performing tasks; Porath, Spreitzer, Gibson, & Garnett, 2012; Spreitzer, Sutcliffe, Dutton, Sonenshein, & Grant, 2005). Both vitality and learning must be present in individuals for them to be considered to be thriving (Porath et al., 2012). Individuals who possess autonomous motivation for a task (i.e., through interaction with a need-supportive social agent) often report enhanced vitality, sense of perceived competence and learning (Deci & Ryan, 2000), as opposed to those with controlled motivation (Nix, Ryan, Manly, & Deci, 1999). Therefore, scales with evidence of valid and reliable reports of need-supportive behaviors should show a positive association with students' reports of their behavioral engagement and thriving.

Purposes of the Current Study

In summary, the aim of this study was to examine the factorial and convergent validity evidence of a scale that is designed to capture health science educators' behaviors that support basic psychological needs. The observation scale developed by Haerens et al. (2013) for use in physical education contexts was adapted to be a self-report measure of tutors' need support behaviors because at the time of data collection it was the only published instrument that measured the support of each of the three psychological needs. Nevertheless, it is important to clarify that the purpose of our research was to test the factorial structure of a self-report scale in a health education context rather than to test the validity of Haerens et al.'s observation instrument in that context.

Methods

Participants

The sample consisted of 290 students aged 18–41 years (M = 21.44, SD = 4.07) from universities in Western Australia who were enrolled in an undergraduate course in physiotherapy (n = 233) or exercise science (n = 57). The students consisted of 184 females and 101 males (5 did not report their gender). Students' self-reported grade point average (GPA) of their most recently completed academic semester was measured as a categorical variable, with 0.7% of the students scoring < 49%, 9.3% scoring 50–60%, 38.3% scoring 61–70%, 42.4% scoring 71–80%, 9% scoring 81–90%, and 0.3% scoring 91% and above.

Measures

Need-Support Behavior Scale (NSBS)

Students' perceptions of their tutor's support for their autonomy, relatedness, and competence were measured using a 21-item modified version of the NSBS (Haerens et al., 2013). Modifications were made to enhance comprehension (e.g., "applies differentiation" was modified to "tailored his/her teaching practice to the individual needs of students") and cultural nuances (e.g., "pupils" replaced with "students"). Modifications involved reducing the length of each item to be more appropriate for a brief self-report instrument, but without compromising the core content of each item. Responses were recorded on a scale ranging from 0 (= *never*) to 3 (= *always*). The items for this measure are displayed in Table 1.

Behavioral Engagement

Students self-reported their behavioral engagement using a 6-item scale (Jang, Reeve, & Deci, 2010) on a 7-point response set ranging from 1 (= *not at all true*) to 7 (= *extremely true*) using an instructional stem to prompt students to reflect on their class on that day (i.e., "During class today…"). Example items include "I worked hard to do well" and "I listened carefully to the tutor's directions".

Thriving

Students self-reported the vitality and learning dimensions of thriving using a 10-item scale (Porath et al., 2012) with a 7-point response set ranging from 1 (= *strongly disagree*) to 7 (= *strongly agree*) using an instructional stem to prompt students to reflect on their class on that day (i.e., "During class today…"). Example items include "I found myself learning often" and "I felt alive and vital".

Procedures

Tutors and unit coordinators for undergraduate physiotherapy and exercise science courses at both universities were invited via e-mail at the beginning of the university semester to participate in this study. The details of the study were then provided to the students 2 weeks prior to the date

Table 1. Standardized factor loadings for the a priori 4-factor model of the Need-Supportive Behavior Scale (N = 290) analyzed using CFA

Item	*During this class, the tutor/teacher...*	Aut	StrD	Rel	StrB
1	provided students with options or choices	.67*			
11	gave students the opportunity to practice independently or to solve problems on their own without interfering	.66*			
17	encouraged students to ask questions or seek clarification	.63*			
21	provided variation in tasks or exercises	.77*			
2	monitored if students understood the (verbal) instructions for tasks or exercises		.65*		
7	offered assistance during tasks or exercises		.68*		
9	used students as positive role models		.62*		
13	offered students new guidelines, tips or advice during exercises or tasks		.69*		
16	addressed students by their first name when provided with the opportunity		.47*		
19	provided positive feedback		.72*		
3	was enthusiastic or eager			.70*	
5	put effort or energy into the lesson			.79*	
10	took the perspective of students into account			.69*	
12	remained physically nearby students during exercises or tasks			.39*	
14	paid attention to what the students said or did			.69*	
18	tailored his/her teaching practice to the individual needs of students			.78*	
20	asked students questions about their interests, problems or values			.59*	
4	offered a rationale for tasks or exercises				.61*
6	demonstrated tasks or exercises himself/herself (i.e., was a "model" for students)				.48*
8	gave an overview of the content and structure of the lesson				.49*
15	provided clear (verbal) instructions				.64*

Note. Aut = Autonomy Support; Rel = Relatedness Support; StrB = Structure Before the Activity; StrD = Structure During the Activity; CFA = Confirmatory Factor Analysis. *$p < .001$.

of data collection to allow sufficient time for them to decide if they wished to participate or not. In total, 14 tutors and 14 classes participated in this study. On the day of collection, tutors ran the classes normally, except that 10 min was allocated at the end of the session for students to complete paper copies of the survey package and consent form. One researcher was present to administer and collect the survey packages. Data collection occurred around the middle of the university semester to allow students time to familiarize themselves with the tutor's teaching styles. Ethical clearance was obtained from Curtin University's Human Research Ethics Committee prior to data collection. All raw data are available on the Open Science Framework (http://bit.ly/2Fzlocp).

Data Analyses

Objective 1

A series of factor analyses were performed to evaluate the factorial validity of the NSBS. First, as there was an a priori expectation regarding the dimensionality of the NSBS (Haerens et al., 2013), we used confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM) with target rotations (Asparouhov & Muthén, 2009) to test the viability of the hypothesized 4-factor model. Within the context of ESEM, target rotations are used to estimate freely cross-loadings on unintended factors with a target value as close to zero as possible; non-intended factor loadings in CFA are forced to equal zero. Second, because the a priori measurement did not fit the data well, ESEM with geomin rotation was subsequently applied to identify an optimal factorial solution. Third, we tested and compared correlated first-order structures with a bifactor approach within ESEM to examine the viability of a general basic psychological needs factor. Bifactor ESEM (B-ESEM) with orthogonal factors permits the simultaneous modeling of a general need support factor alongside specific need support factors (e.g., autonomy support behaviors; Jennrich & Bentler, 2011, 2012). All factor analyses were implemented in M*plus* 8 (Muthén & Muthén, 2017) using a robust variance-adjusted weighted least squares estimator (WLSMV). A multifaceted approach is typically employed to assess model-data fit, which includes the χ^2 goodness-of-fit index, comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA). Based on commonly adopted recommendations (Marsh, Hau, & Grayson, 2005) CFI and TLI values $\geq$ .90 and RMSEA values under .08 are considered to indicate acceptable fit. To compare nested models, we employed the χ^2 difference test via the DIFFTEST function in M*plus* (Asparouhov & Muthén, 2006), alongside

Table 2. Standardized factor loadings for the a priori 4-factor model of the Need-Supportive Behavior Scale (N = 290) analysed using ESEM with target rotations

Item	*During this class, the tutor/teacher…*	Aut	StrD	Rel	StrB
1	provided students with options or choices	.50*	.47*	.83*	.40*
11	gave students the opportunity to practice independently or to solve problems on their own without interfering	.47*	.58*	.83*	−.38*
17	encouraged students to ask questions or seek clarification	.20	.27	.16	.34*
21	provided variation in tasks or exercises	.67*	.46*	−.33*	.49*
2	monitored if students understood the (verbal) instructions for tasks or exercises	−.08	.01	.05	−.10
7	offered assistance during tasks or exercises	.02	.45*	.38*	−.17
9	used students as positive role models	.53*	.14	.13	.10
13	offered students new guidelines, tips or advice during exercises or tasks	.20*	.50*	.28*	.16*
16	addressed students by their first name when provided with the opportunity	.23*	.14	−.01	.07
19	provided positive feedback	.29*	−.12	.37*	.08
3	was enthusiastic or eager	−.04	.01	.30*	.03
5	put effort or energy into the lesson	−.08	.15	.40*	.45*
10	took the perspective of students into account	.48*	.31*	.22*	.41*
12	remained physically nearby students during exercises or tasks	−.13	.61*	.01	.05
14	paid attention to what the students said or did	.16*	.36*	−.11	.10
18	tailored his/her teaching practice to the individual needs of students	.37*	.19*	.06	.11
20	asked students questions about their interests, problems or values	.52*	.10	.19*	−.06
4	offered a rationale for tasks or exercises	.09	.04	.34*	.38*
6	demonstrated tasks or exercises himself/herself (i.e., was a "model" for students)	.15	.54*	.25*	.41*
8	gave an overview of the content and structure of the lesson	−.03	.30*	.07	.12
15	provided clear (verbal) instructions	−.15	.35*	.21*	.30*

Note. Aut = Autonomy Support; Rel = Relatedness Support; StrB = Structure Before the Activity; StrD = Structure During the Activity; ESEM = Exploratory Structural Equation Modeling. Gray shade: intended factor loading. *$p < .05$.

changes in model-data fit indices, such that the more complex model was favored when the change in CFI was less than .01 and change in RMSEA was no greater than .015 (Marsh et al., 2010). Assessments of the quality of factor loadings were guided by Comrey and Lee's (1992) recommendations: > .71 = excellent, > .63 = very good, > .55 = good, > .45 = fair, < . 30 = poor. Internal reliability evidence of each latent factor was assessed using a composite reliability coefficient (McDonald, 1970). For exploratory analyses, only salient indicators (i.e., ≥ .40 factor loading) were utilized to calculate composite reliability. Missing data were handled using full information maximum likelihood (FIML). FIML includes all available data in the analysis thereby generating parameter estimates that are less inflated when compared to those obtained with other techniques (e.g., listwise deletion) (Graham, 2009).

Objective 2

To evaluate the convergent validity of the NSBS, we used multivariate regression with a robust maximum likelihood estimator (MLR) in M*plus* 8. This approach permitted a test of the association between need-supportive behaviors and behavioral engagement and thriving (learning and vitality dimensions), while controlling for age and GPA.

Results

Objective 1: Factorial Validity Evidence

There was a negligible amount of missing data in this sample (0.005%) and therefore the use of FIML was deemed appropriate in subsequent analyses. With regard to the a priori 4-factor model of the NSBS (Haerens et al., 2013), CFA indicated acceptable model-data fit, $\chi^2(182)$ = 382.59, $p < .001$, CFI = .930, TLI = .920, RMSEA = .061 (90% CI [.053, .070]). ESEM with target rotations also supported the model-data fit of the correlated 4-factor model, $\chi^2(132) = 169.57$, $p = .015$, CFI = .987, TLI = .979, RMSEA = .031 (90% CI [.015, .044]). Standardized factor loadings are provided in Tables 1 and 2, with latent factor correlations and internal reliability estimates detailed in Table 3. An inspection of the factor loadings for the CFA model indicated that all but four items evidence good quality factor loadings (≥ .55); the loadings of those four items were deemed to be fair (≥ .39). All factors with the exception of structure before the activity evidenced adequate internal reliability evidence (i.e., > .70). The correlations among the latent factors indicated that they could not be discriminated from each other (see Table 3), such that the covariance matrix was not positive definite. Thus, the CFA solution

Table 3. Standardized latent factor correlations and internal reliability estimates of all factor analyses

	CFA (4-factor)				4-factor ESEM (target)			
	StrD	Aut	Rel	StrB	StrD	Aut	Rel	StrB
StrD	(.81)				(.50)			
Aut	.86*	(.78)			.34*	(.53)		
Rel	.98*	.97*	(.85)		.44*	.38*	(.58)	
StrB	1.08*	.78*	.94*	(.64)	.40*	.32*	.29*	(.44)
	4-factor ESEM (geomin)							
	F1	F2	F3	F4				
F1	(.78)							
F2	.34*	(.83)						
F3	.44*	.38*	(.68)					
F4	.40	.32	.29	(.38)				
	3-factor ESEM (geomin)							
	F1	F2	F3					
F1	(.80)							
F2	.66*	(.86)						
F3	.29*	.38*	(.66)					
	2-factor ESEM (geomin)							
	F1	F2						
F1	(.88)							
F2	.62*	(.82)						

Note. Composite reliabilities reported on the diagonal in parentheses. Aut = Autonomy Support; Rel = Relatedness Support; StrB = Structure Before the Activity; StrD = Structure During the Activity; CFA = Confirmatory Factor Analysis; ESEM = Exploratory Structural Equation Modeling; F1, F2, F3, and F4 = Specific Factors. *$p < .05$.

was inadmissible. In contrast, ESEM revealed numerous inconsistencies in both intended and non-intended factor loadings of the hypothesized 4-factor structure. Intended factor loadings ranged in magnitude from .01 to .67, yet 9 of the 21 items (43%) were small and nonsignificant. With regard to cross-loadings, 34 (54%) were statistically significant, with 19 loadings (30%) at a meaningful magnitude (> .35). Latent factor reliabilities were unsatisfactory. As such, the ESEM data support global fit (i.e., model-data congruence) but not local fit (i.e., pattern of factor loadings) of the hypothesized 4-factor model.

We subsequently took an exploratory approach using ESEM to identify the best fitting factor structure of the NSBS. An overview of the factor loadings for the unidimensional and correlated 2-factor and 3-factor models is provided in Table 4; the 4-factor model is detailed in Table 5. A correlated 4-factor model was an acceptable fit with the data, $\chi^2(132) = 169.57$, $p = .015$, CFI = .987, TLI = .979, RMSEA = .031 (90% CI [.015, .044]). However, an inspection of the factor loadings revealed several items with meaningful loadings on two or more factors ($\geq$ .30), and few primary loadings that were considered good ($\geq$ .55). Reliability estimates were satisfactory for two of the four latent factors (i.e., > .70). Collectively, these findings suggest a degree of local misfit between the data and model, such that the four factors appeared uninterpretable. There was evidence of good fit for a correlated 3-factor model, $\chi^2(150) = 216.16$, $p < .001$, CFI = .977, TLI = .967, RMSEA = .039 (90% CI [.027, .050]). The χ^2 difference test indicated that the 3-factor model fit was a significantly worse fit with the data when compared with the 4-factor model, $\Delta\chi^2(18) = 44.49$, $p < .001$, although this interpretation did not extend to the change in model-fit statistics (ΔCFI = .10, ΔRMSEA = .008). Nevertheless, several items evidenced meaningful loadings on two or more factors ($\geq$ .30), with the strength of primary factor loadings mostly less than good ($\leq$ .55). Overall, the interpretability of the factors in relation to the support of three psychological needs of autonomy, competence, and relatedness was unclear.

A correlated 2-factor ESEM model was an acceptable fit with the data, $\chi^2(169) = 311.93$, $p < .001$, CFI = .950, TLI = .938, RMSEA = .054 (90% CI [.045, .063]), yet was a significantly worse fit when compared with the 3-factor model, $\Delta\chi^2(19) = 84.25$, $p < .001$, ΔCFI = .27, ΔRMSEA = .015. The strength of primary factor loadings was primarily fair to good (.45–.63), with only one instance of a meaningful cross-loading; however, two items did not evidence statistically significant loadings on either of the factors. An inspection of the item content suggested that Factor 1 could be interpreted as a combination of behaviors that address students' needs for autonomy and relatedness, whereas Factor 2 was primarily concerned with the need for competence. The correlation between the 2 factors was moderate-to-large ($r = .62$), suggesting some overlap in substantive content. Finally, there was evidence of good fit for a unidimensional (i.e., 1-factor) model, $\chi^2(189) = 409.61$, $p < .001$, CFI = .923, TLI = .914, RMSEA = .063 (90% CI [.055, .072]), but a significantly worse fit when compared with the 2-factor model, $\Delta\chi^2(20) = 92.76$, $p < .001$, ΔCFI = .27, ΔRMSEA = .007. The scale was internally reliable (α = .87), with the quality of the factor loadings classified as good for all but four items ($n = 17$, 81%).

A series of B-ESEM were performed to test whether a general basic psychological needs support factor underlies all of the items, in addition to specific domains of needs supportive behaviors. The results of these analyses are detailed in Table 6. The model with a general factor and 4-specific domains was an acceptable fit with the data, $\chi^2(115) = 216.16$, $p = .14$, CFI = .977, TLI = .967, RMSEA = .039 (90% CI [.027, .050]). The model with a general factor and 3-specific domains was an acceptable fit with the data, $\chi^2(132) = 169.57$, $p < .05$, CFI = .987, TLI = .979, RMSEA = .031 (90% CI [.015, .044]). The χ^2 difference test indicated that the 3-factor model fit was a

Table 4. Standardized factor loadings of 1-factor and correlated 2-factor ESEM solutions for Need-Supportive Teaching Behaviors

		Unidimensional	2-Factor		3-Factor		
Item	*During this class, the tutor/teacher…*	F1	F1	F2	F1	F2	F3
1	provided students with options or choices	.63*	.77*	−.13	.14	.64*	−.17
2	monitored if students understood the (verbal) instructions for tasks or exercises	.65*	.26	.48*	.61*	.00	.25*
3	was enthusiastic or eager	.70*	.52*	.25	.85*	.01	−.11
4	offered a rationale for tasks or exercises	.60*	.33	.34	.32*	.24*	.19
5	put effort or energy into the lesson	.79*	.52*	.35	.95*	−.03	−.02
6	demonstrated tasks or exercises himself/herself (i.e., was a 'model' for students)	.47*	.38*	.13	.37*	.18	−.01
7	offered assistance during tasks or exercises	.67*	.23	.54*	.45*	.12	.34*
8	gave an overview of the content and structure of the lesson	.48*	.03	.54*	.20	.10	.40*
9	used students as positive role models	.62*	.62*	.03	−.08	.71*	.05
10	took the perspective of students into account	.69*	.70*	.02	.09	.66*	−.01
11	gave students the opportunity to practice independently or to solve problems on their own without interfering	.62*	.58*	.08	−.01	.64*	.06
12	remained physically nearby students during exercises or tasks	.39*	−.33*	.81*	−.02	−.02	.72*
13	offered students new guidelines, tips or advice during exercises or tasks	.68*	.15	.64*	.00	.41*	.56*
14	paid attention to what the students said or did	.68*	.21	.58*	.14	.35*	.44*
15	provided clear (verbal) instructions	.63*	.00	.74*	.41*	−.01	.52*
16	addressed students by their first name when provided with the opportunity	.47*	.27	.24	−.02	.40*	.21*
17	encouraged students to ask questions or seek clarification	.59*	.48*	.16	.36*	.31*	.01
18	tailored his/her teaching practice to the individual needs of students	.78*	.69*	.15	.32*	.55*	.01
19	provided positive feedback	.72*	.49*	.31	.26*	.44*	.18
20	Asked students questions about their interests, problems or values	.59*	.64*	−.04	−.10	.73*	−.03
21	Provided variation in tasks or exercises	.72*	.91*	−.18	.00	.88*	−.19*

Note. ESEM = Exploratory Structural Equation Modeling. Gray shade: salient factor loading (i.e., ≥ .40). *$p < .05$.

significantly worse fit with the data when compared with the 4-factor model, $\Delta\chi^2(17) = 38.98$, $p < .01$, although this interpretation did not extend to the change in model-fit statistics, ΔCFI = .10, ΔRMSEA = .008. The model with a general factor and 2-specific domains was an acceptable fit with the data, $\chi^2(150) = 216.16$, $p < .05$, CFI = .977, TLI = .967, RMSEA = .039 (90% CI [.027, .050]). The χ^2 difference test indicated that the 2-factor model fit was a significantly worse fit with the data when compared with the 3-factor model, $\Delta\chi^2(18) = 44.49$, $p < .001$, although this interpretation did not extend to the change in model-fit statistics, ΔCFI = .10, ΔRMSEA = .008. Across all models, items loaded strongly on the general factor. However, factor loadings for specific domains were overall lower in magnitude, and included several negative factor loadings. These findings suggest that the variance in item responses were influenced primarily by the general factor rather than specific domains of needs satisfaction behaviors. In summary, these analyses indicated that the best factorial structure of the NSBS in terms of model fit, item loadings, and factor interpretability was the unidimensional model obtained via ESEM.

Objective 2: Convergent Validity Evidence

Based on the results from the factor analyses, we proceeded to test the convergent validity for the unidimensional model. An overview of the results of the multivariate regression analysis is detailed in Table 7. In terms of the covariates, GPA in the previous academic semester was positively associated with behavioral engagement and the learning dimension of thriving. The unidimensional need-supportive behaviors factor evidenced a positive association with behavioral engagement and both the learning and vitality dimensions of thriving. Collectively, age, GPA, and need-supportive behaviors (1-factor) explained a small-to-moderate amount of variance in behavioral engagement

Table 5. Standardized factor loadings of correlated 4-factor ESEM solution for Need-Supportive Teaching Behaviors

Item	*During this class, the tutor/teacher...*	F1	F2	F3	F4
1	provided students with options or choices	.12	.59*	−.17*	.20
2	monitored if students understood the (verbal) instructions for tasks or exercises	.58*	−.05	.24*	.22
3	was enthusiastic or eager	.85*	.05	−.11	−.04
4	offered a rationale for tasks or exercises	.36*	.29*	.21	−.19
5	put effort or energy into the lesson	.91*	.00	−.01	.03
6	demonstrated tasks or exercises himself/herself (i.e., was a "model" for students)	.31	.04	−.05	.53*
7	offered assistance during tasks or exercises	.40*	.05	.34*	.29*
8	gave an overview of the content and structure of the lesson	.21	.10	.41*	−.02
9	used students as positive role models	−.10	.65*	.05	.20
10	took the perspective of students into account	.07	.57*	−.01	.27
11	gave students the opportunity to practice independently or to solve problems on their own without interfering	−.06	.49*	.06	.43*
12	remained physically nearby students during exercises or tasks	−.06	−.05	.73*	.11
13	offered students new guidelines, tips or advice during exercises or tasks	.00	.40*	.56*	.03
14	paid attention to what the students said or did	.14	.36*	.45*	−.01
15	provided clear (verbal) instructions	.42*	.02	.54*	−.09
16	addressed students by their first name when provided with the opportunity	.02	.43*	.23*	−.19
17	encouraged students to ask questions or seek clarification	.35*	.30*	.02	.06
18	tailored his/her teaching practice to the individual needs of students	.31*	.52*	.02	.09
19	provided positive feedback	.22	.37*	.18	.27
20	asked students questions about their interests, problems or values	−.06	.76*	.00	−.15
21	provided variation in tasks or exercises	.03	.90*	−.19*	−.07

Note. ESEM = Exploratory Structural Equation Modeling. Gray shade: salient factor loading (i.e., > .40). *$p < .05$.

Table 6. B-ESEM solutions for Need-Supportive Teaching Behaviors

	2-domains			3-domains				4-domains				
Item	G	F1	F2	G	F1	F2	F3	G	F1	F2	F3	F4
1	.54*	.12	.42*	.66*	−.06	−.22*	.03	.58*	.08	.08	.23*	−.26*
2	.69*	.18	−.12	.62*	.25	.18	−.25	.65*	.19	.18	−.02	.22*
3	.66*	.51*	.04	.65*	.54*	−.11	−.03	.65*	.58*	−.04	.04	−.01
4	.60*	.04	.04	.56*	.24*	.18	.20	.61*	.13	−.24	.02	.05
5	.77*	.51	−.03	.73*	.55*	−.03	−.11	.74*	.51*	.06	−.05	.04
6	.45*	.18	.09	.51*	−.02	−.11	−.43*	.46*	.07	.61*	.00	−.02
7	.71*	.02	−.09	.65*	.09	.25*	−.25*	.69*	.01	.24*	−.06	.20
8	.53*	−.14	−.13	.43*	.08	.35*	.02	.50*	−.04	−.13	.04	.26
9	.56*	−.13	.37*	.65*	−.23*	−.03	.06	.60*	−.17	.07	.19*	−.19
10	.62*	.00	.36*	.71*	−.13	−.09	−.04	.62*	.04	−.02	.93*	−.04
11	.56*	−.09	.32*	.65*	−.27*	−.04	−.18	.57*	−.16	.25	.21*	−.10
12	.46*	−.43	−.33	.30*	−.15	.64*	−.11	.41*	−.38*	−.01	−.14	.44
13	.73*	−.36	−.02	.65*	−.12	.46*	.09	.73*	−.31*	−.08	−.05	.17
14	.71*	−.21	.00	.64*	.00	.37*	.10	.70*	−.14	−.14	.03	.16
15	.70*	−.09	−.24*	.55*	.24	.47*	.02	.65*	.04	−.18	−.02	.38*
16	.46*	−.17	.13	.44*	.01	.19	.28*	.48*	−.10	−.25*	.01	−.03
17	.57*	.16	.15	.59*	.16	−.02	.02	.59*	.13	.06	−.07	−.12
18	.73*	.12	.29*	.79*	.09	−.04	.07	.77*	.07	.08	−.01	−.19
19	.71*	.00	.15	.73*	−.03	.10	−.11	.71*	−.03	.16	.12	.02
20	.51*	−.09	.41*	.59*	−.07	−.04	.37*	.59*	−.11	−.17	−.03	−.34
21	.61*	.04	.56*	.75*	−.05	−.22	.34*	.71*	−.01	−.07	.02	−.52*

Note. B-ESEM = Bi-Factor Structural Equation Modeling; G = General Factor; F1, F2, F3, and F4 = Specific Factors. Gray shade: salient factor loading (i.e., > .40). *$p < .05$.

Table 7. Standardized regression coefficients of multivariate regression including age, GPA, and need-supportive behaviors as predictors of behavioral engagement and thriving (n = 290)

	Engagement	Learning	Vitality	Mean (*SD*)	Cronbach's α
GPA	.13* (.02, .25)	.15* (.04, .26)	.10 (−.01, .20)	3.52 (0.80)	–
Age	.11 (−.01, .23)	.07 (−.03, .17)	.04 (−.05, .14)	21.44 (4.07)	–
NSBS (1-factor)	.31** (.17, .44)	.52** (.40, .65)	.44** (.33, .55)	2.56 (0.34)	.87
Mean (*SD*)	5.86 (0.83)	5.74 (0.83)	5.04 (0.93)		
Cronbach's α	.84	.83	.79		

Note. GPA = Grade Point Average; NSBS = Need-Supportive Behaviors Scale; 95% confidence intervals reported in parentheses. *p < .05; **p < .001.

(12%), learning (30%), and vitality (20%) in the total sample.

Discussion

This study tested the psychometric properties of a scale that captures tutor support of all three psychological needs among samples of tertiary students studying health sciences. Our results showed that the a priori 4-factor model (Haerens et al., 2013) did not generalize to a tertiary education setting. Further analyses offered support for a unidimensional need-supportive behaviors factor. Convergent validity analyses suggested associations between this unidimensional factor with behavioral engagement and thriving that were in line with our theory-based expectations.

Factorial Validity Evidence

Our results on the dimensionality of need supportive behaviors did not align with theoretical (Deci & Ryan, 2000) and empirical expectations (Haerens et al., 2013). Our analyses indicated that there appeared to be one primary latent factor that explained the variance in students' responses (i.e., moderate-to-high factor loadings), thereby suggesting that the participants did not make sufficient distinctions between items that captured supports for autonomy and relatedness, and the two dimensions of structure. For example, although the provision of choice is often stated as a key behavior designed to support one's need for autonomy, it is possible that participants may also perceive this behavior as one that satisfies their desire for competence (e.g., "my tutor thinks that I am capable and competent and thus allows me input into the decision making process") and/or relatedness (e.g., "my teacher cares about me and therefore seeks my input in the decision making process").

Methodological differences may explain these inconsistencies in findings. Whereas the study from where we adapted the scale utilized experts' rating of observational data (Haerens et al., 2013), our study involved self-reports of perceived teacher behaviors. Rating scales between the two studies were different and raters were asked to repeatedly rate the social environment within a particular lesson, which obviously was not the case with our self-report measure. Also, the experts in the Haerens et al. study were probably able to better differentiate behaviors that are specifically designed to satisfy each of the individual needs. Often in such type of studies observers receive prior training in identifying and discriminating among different dimensions of a motivational environment, which is not the case with participants completing self-report measures. Hence, although we tried to retain the essence of each item from the Haerens et al. study, the methodological differences in how the two scales were rated (and by whom) can confound the differences found in the factorial structures of the two scales. Nevertheless, evidence of very high factor correlations among self-reported need support dimensions has also emerged in other settings. For example, the Need Support for Exercise Scale (Markland & Tobin, 2010) has a one-factor model of "need support" that includes items tapping the support of all three needs. This unidimensional approach was adopted on the basis of very high factor correlations being encountered when a three factor approach was modeled (Markland, personal communication, July 3, 2017). It should also be noted that Haerens et al. (2013) reported item cross-loadings and variable inter-rated reliability (i.e., good for structure before the activity and autonomy support, moderate for structure during the activity, and poor for relatedness support), hence it is likely that the four-structure solution they presented might have been problematic.

The unidimensional measurement of need support in our study aligns well with the writings of Deci and Ryan. In their recent work (e.g., Deci, Olafsen, & Ryan, 2017), the two creators of SDT refer to "need supportive environments," without making a distinction to need-specific dimensions. Potentially the examination of need specific dimensions would be of more interest in experimental work which aims to isolate these dimensions and examine their independent effects on various outcomes. However, in non-experimental work the three dimensions have conceptual and measurement overlap; when examining the role of supportive social environments in a network of other

variables (e.g., psychological needs, several types of motivation regulations) a parsimonious representation of the social environment as "need supportive" could suffice for practical reasons and could still be in line with theory.

Convergent Validity Evidence

The findings on convergent validity were consistent with our expectations, such that students who perceived higher levels of need-supportive behaviors from their tutor reported higher levels of behavioral engagement and thriving. These relations are in line with past studies that have also found positive associations between motivational climates and behavioral engagement (Stroet et al., 2013) and thriving (Nix et al., 1999). For example, encouraging students to ask questions and seek clarification would directly increase behavioral engagement through active participation, whereas using students as positive role models and providing positive feedback would likely increase their sense of vitality and learning, respectively. On the other hand, certain need-supportive behaviors may have an influence on both behavioral engagement and thriving. For instance, the act of asking students about their interests, problems, and values may improve their engagement by encouraging participation in active discussion, improve their sense of vitality through discussion of interests, and provide a sense of learning through reflection of one's own problems and troubleshooting them accordingly.

Strengths and Limitations

A key strength of this study was the use of tutorial classes that captured a breadth of activities (e.g., physical exercises and theory) and concepts (e.g., biomechanics and exercise physiology) across two related but different health professions. To date, there are no instruments to assess the provision of need support by tutors of tertiary health education students. Our study was limited to the assessment of motivational strategies that are hypothesized to support students' basic psychological needs. As behaviors that may thwart the satisfaction of students' psychological needs were excluded in our study, further research is required to determine what effects such behaviors could have on behavioral engagement and thriving. Hence, a future revision of this scale should include items that also capture need thwarting behaviors. Our sampling of students studying two distinct courses might also have affected the findings; due to the unbalanced and small sample of exercise science students we were unable to test for measurement equivalence across these two cohorts. Lastly, further studies need to be replicated in other populations of university students to further strengthen the conclusion, as our findings could be sample specific.

Conclusion

We found support for a unidimensional measure of need support that is aligned with theory (Deci et al., 2017) and represents a parsimonious way of capturing the social environment, particularly in survey studies testing a nomological network of motivation-related predictors and outcomes. Further work in tertiary health education settings is needed to test the generalizability of our findings and conclusions regarding the factorial structure of this scale. This instrument is the first to assess perceptions of need support by university tutors in health education settings. Future research can focus on additional examinations of the structural properties of test scores obtained with this scale (e.g., measurement invariance), and test whether interventions targeted at increasing these need supportive behaviors of university tutors in health education can predict other important student outcomes (e.g., psychological need satisfaction, autonomous motivation, grades).

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ORCID
Daniel F. Gucchiardi
https://orcid.org/0000-0001-5448-3990

Daniel F. Gucciardi
School of Physiotherapy and Exercise Science
Curtin University
GPO Box U1987
Perth, NSW 6845
Australia
daniel.f.gucciardi@gmail.com

