Associations among instructor behaviors, psychological need satisfaction, motivation, and participation in group exercise classes

JULIA LOHMANN*, MEGHAN MCDONOUGH**, JENNIFER BREITHECKER***
CHRISTINA ROGLER***, HANS-PETER BRANDL-BREDENBECK***,
PETRA GIEß-STÜBER*

(*) *Insitute of Sport und Sport Science, Albert-Ludwigs-University of Freiburg, Germany*
(**) *Faculty of Kinesiology, University of Calgary, Canada*
(***) *Institute of Sport Science, University of Augsburg, German*

We investigated the associations among perceived instructor behaviors, psychological need satisfaction, motivation, and participation frequency in group exercise classes. 926 participants (M_{age} = 23.85, SD_{age} = 5.82, $N_{females}$ = 773) from 80 group exercise classes took part in the cross-sectional survey. We used multilevel structural equation modeling to estimate direct and indirect effects. Perceived instructor behavior (individualized and specific feedback, clear and precise instruction, care and individual consideration, praise and encouragement) was associated with need satisfaction and self-determined motivation and to a lesser but significant extent, participation. Small positive indirect effects were found between perceptions of instructor behaviors and participation frequency, mediated by the three needs and intrinsic motivation (β = .01-.02). Purposefully applying those specific instructor behaviors in group exercise classes may be an effective route for promoting psychological need satisfaction, intrinsic motivation, and participation in exercisers. Instructors should be aware that participants' autonomy, competence, and relatedness satisfaction play different roles for behavioral regulations and therefore exercise participation.

KEY WORDS: Autonomy, Competence, Intrinsic Relatedness.

High dropout rates from exercise classes (40-60% within the first year; Davies, Coleman, & Stellino, 2016) suggest that adherence could be improved if motivation in group exercise was better understood. Instructors

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Correspondence to: Julia Lohmann, Institu of Sport and Sport Sciences, "Insitute of Sport Science, University of Augsburg" of Freiburg, Germany (e-mail: julia.lohmann@sport.uni-augsburg.de)

play a vital role in shaping the exercise environment, and thus have tremendous potential to influence participant motivation (Edmunds, Ntoumanis, & Duda, 2008; Kinnafick, Thøgersen-Ntoumani, Duda, & Taylor, 2014; Quested, Ntoumanis, Stenling, & Thøgersen-Ntoumani, & Hancox, 2018; Wagner, 2000). However, how specific instructor behaviors predict participants' motivation is not fully understood.

This study examined the associations between specific perceived instructor behaviors (individualized and specific feedback, clear and precise instruction, care and individual consideration, and praise and encouragement; Author citation, under review), psychological need fulfillment and behavioral regulation within a self-determination theory framework (Deci & Ryan, 2002), and exercise participation. Our aim was to investigate whether perceived instructor behaviors predict behavioral regulation and participation, and whether these associations are mediated by psychological need satisfaction in young adults participating in group exercise.

Self-determination theory as a conceptual framework

Self-determination theory (SDT; Deci & Ryan, 2002) and its mini-theories of organismic integration and basic psychological needs (Ryan & Deci, 2002) provide a well-supported framework for understanding exercise motivation (for reviews, see Ntoumanis, Quested, Reeve, & Cheon, 2018; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Within organismic integration theory, Ryan and Deci (2002) propose that there are several behavioral regulations for exercise that range on a continuum from less to more self-determined. Individuals are not self-determined if they are *amotivated* (lack intention to act, do not see a connection between effort and desired outcomes) and most self-determined when they are *intrinsically* motivated (acting for pleasure and satisfaction inherent in the activity; Ryan & Deci, 2002). Between these extremes are several forms of extrinsic motivation. The least self-determined is *external* regulation (striving for rewards, avoiding punishments administered by others), followed by *introjected* regulation (acting to avoid feelings of guilt and shame, to attain ego-enhancement), *identified* regulation (behaviors and goals are valued as personally important and experienced as more internally controlled), and *integrated* regulation (behavior is congruent with one's core values and beliefs; Ryan & Deci, 2002). In the SDT literature the behavioral regulations are often divided into autonomous (intrinsic, integrated and identified) and controlled forms of motivation (introjected and external; Davies et al., 2016; Ntoumanis, Thøgersen-

Ntoumani, Quested, & Hancox, 2017). Promoting autonomous forms of motivation within the exercise context leads to better exercise participation (Teixeira et al., 2012). According to basic psychological needs theory, the psychological needs for *autonomy* (personal control and volition), *competence* (effectiveness in dealing with the environment), and *relatedness* (interacting, and feeling connected and cared for) are fundamental for experiencing autonomous motivation (Ryan & Deci, 2002). Satisfaction of these needs is expected to result in the internalization of values and goals. Internalization facilitates self-determined motivation, which is thought to lead to exercise adherence.

The Role of the Exercise Instructor for Motivation and Exercise Participation

Social context factors, such as exchanges with exercise leaders, are proposed antecedents to the psychological need satisfaction → motivation → participation sequence (Vallerand, 2007). Exercise instructors who better meet participants' psychological needs are more likely to promote self-determination and exercise participation (Edmunds et al., 2008; Ntoumanis et al., 2017). The need supportiveness of the exercise environment (e.g. created by staff at the exercise facility) is characterized by the provision of autonomy support (acknowledging exercisers' feelings, providing choice, encourageing initiative), structure (providing clear guidance and expectations, and timely and informative feedback), and involvement (dedicating time and energy to exercisers, establishing a caring atmosphere) (Edmunds et al., 2008; Hancox, Quested, Ntoumanis, & Thøgersen-Ntoumani, 2017; Quested et al., 2018). Students of instructors who have been trained to be need supportive are found to have higher attendance (Edmunds et al., 2008) and intentions to attend exercise classes (Ntoumanis et al., 2017) compared to students of untrained instructors. Many studies address perceptions of autonomy support, and in some cases also structure and involvement (Edmunds et al., 2008; Ntoumanis et al., 2017). Often, these concepts are collapsed into a general perception of need support score (Mack, Gunnell, Wilson, & Wierts, 2017; Markland & Tobin, 2010). Such approaches are useful in that they address the role of the need supportiveness of the exercise environment as an indicator of motivational climate. But less is known about specific perceived instructor behaviors and how they predict exercise motivation and behavior.

Different theoretical and empirical conceptualizations have been used to investigate instructor behaviors that may be associated with adaptive outcomes in the exercise domain. In qualitative work by Pahmeier (1994) five

functions of exercise instructors were identified that facilitate adherence: correction and control, activator, professional competence for exercise, expert to whom questions may be addressed, and the responsibility for the group climate. These functions predict exercise adherence over a 10-week and a one-year exercise program (Wagner, 2000). Further, beyond receiving individual feedback and having a selection of exercises (Edmunds et al., 2008; Ntoumanis et al., 2017), the facilitation of social cohesion, and the provision of social support are important for program attendance (Estabrooks et al., 2004; Izumi et al., 2015; Loughead, Colman, & Carron, 2001). To promote social cohesion and provide social support, instructors should take into account individual needs, establish relationships with individuals and involve participants in decisions (Estabrooks et al., 2004; Izumi et al., 2015). Furthermore enthusiasm, motivating class members, and being availabile outside of the class may predict group cohesion and adherence, but evidence for these behaviors is mixed (Loughead et al., 2001). Taken together, specific instructor behaviors such as structuring the exercise class, individual feedback, social support, enthusiasm and activation, may be important for facilitating exercise participation. More detailed investigation of such specific instructor behaviors within the SDT motivational process of need satisfaction → motivation → exercise participation may further our understanding of how instructors can facilitate exercise participation.

In order to elucidate specific instructor behaviors in the context of group exercise classes Herb and Gieß-Stüber (2018) observed instructors and analyzed their behaviors based on the SDT framework. They identified seven aspects of instructor behavior that are facilitative for psychological need satisfaction: (a) provision of specific and individual feedback, (b) concise instruction and movement control, (c) structuring exercises, (d) additional explanations and rationale for exercises, (e) change in perspectives (i.e., empathize with participants), (f) caring for individuals (i.e., take their different performance levels into account), (g) activating language and encouragement. In order to quantify these context-specific instructor behaviors and assess them in larger samples from the perspective of participants, in previous work we developed a questionnaire and validated it in two separate samples (Author citation, under review). Exploratory and confirmatory factor analyses supported four dimensions of perceived instructor behavior: individualized and specific feedback, clear and precise instruction, care and individual consideration, and praise and encouragement. Furthermore, individualized and specific feedback negatively predicted autonomy need satisfaction, and was a positive predictor for external regulation. Clear and precise instruction explained significant variance in competence need

satisfaction. Care and individual consideration positively predicted all thre psychological needs and praise and encouragement was a positive predictor for intrinsic motivation.To date, however, the processes and pathways (e.g., indirect effects) through which these perceived instructor behaviors are linked to adaptive outcomes have not been investigated.

The Role of Psychological Needs and Behavioral Regulations as Mediators

Applying SDT to the exercise context, instructor behaviors should lead to exercise behavior to the extent that they satisfy psychological needs, and in turn enhance autonomous motivation (Ntoumanis et al., 2018; Teixeira et al., 2012). Identified regulation and intrinsic motivation are strong predictors of exercise behavior, whereas less self-determined regulations have weaker effects, or mixed evidence (Teixeira et al., 2012). Competence need satisfaction is typically positively linked to group exercise participation (Fortier, Sweet, O'Sullivan, & Williams, 2007; Vlachopoulos & Michailidou, 2006). Evidence regarding autonomy need satisfaction is mixed (Teixeira et al., 2012). Relatedness has not consistently been associated with exercise behavior, but few studies have examined associations between relatedness and exercise behavior, so it is difficult to draw firm conclusions (Teixeira et al., 2012). Psychological need satisfaction also mediates the association between perceived need support and autonomous exercise motivation (Edmunds, Ntoumanis, & Duda, 2006; Kinnafick et al., 2014; Markland & Tobin, 2010; Puente & Anshel, 2010). But it remains unclear whether the satisfaction of each psychological need mediates the association between social context factors (instructor behavior), and exercise behavior (Kinnafick et al., 2014; Markland & Tobin, 2010).

Previous studies within the SDT framework typically analyzed perceived motivational climate instead of specific instructor behaviors. Whereas evidence regarding positive effects of perceived need supportive climate on exercise participation is strong (Ntoumanis et al., 2018; Teixeira et al., 2012), less is known about which specific instructor behaviors (i.e., specific feedback, activating language, precise instruction, individualized exercises) contribute to a need supportive climate, which is critical for developing practical recommendations. In addition, many studies do not include several types of motivation or the three psychological needs in their analysis due to small sample sizes or measurement problems limiting the capacity to test more complex models (e.g., Edmunds et al., 2006; Fortier et al., 2007; Kinnafick et al., 2014).

Purpose and Hypotheses

The purpose of this study was to first examine whether each of the four dimensions of perceived instructor behavior (individualized and specific feedback, clear and precise instruction, care and individual consideration, and praise and encouragement) predicts psychological need satisfaction, motivation, and participation in registered exercise classes; and second examine whether psychological need satisfaction and motivation mediate the association between each perceived instructor behavior and exercise participation among adults in group exercise classes. It was first hypothesized that participants who perceive their group exercise instructors to give more individualized and specific feedback, to provide more clear and precise instructions, to care for and consider individuals, and to use more praise and encouraging behaviors will experience greater satisfaction of autonomy, competence, and relatedness needs, be more autonomously motivated and less controlled and participate more frequently than those who perceive less of these instructor behaviors, and second the data will support the motivational sequence whereby greater use of each instructor behavior will predict greater psychological need satisfaction, which will in turn predict more autonomous and less controlled motivation, and ultimately exercise participation (see Figure 1).

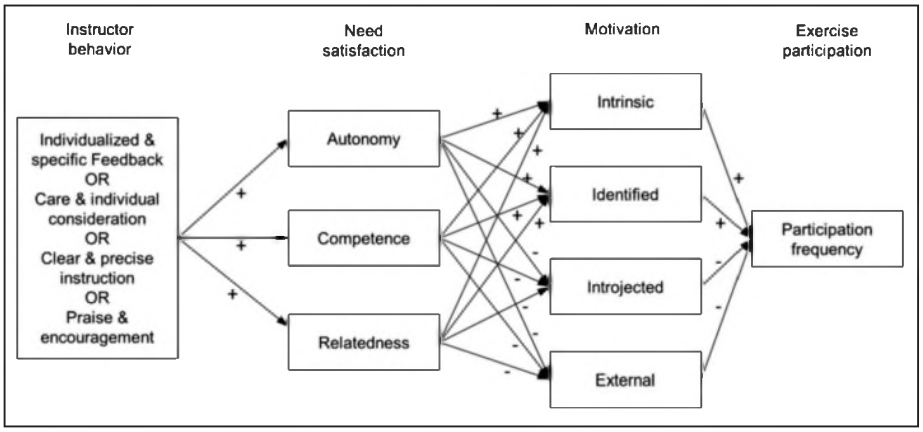

Fig. 1. - Hypothesized relationships among instructor behavior, psychological need satisfaction, motivation, and exercise participation.

Methods

Participants

Participants were adults in one of 80 group exercise classes offered at two universities in southern Germany. Classes included aerobics, back exercises, functional fitness, Zumba, sling training, suspension training, fitness boxing, spinning, and yoga. All individuals who registered for exercise classes at the university sport centers (approximately $N = 1900$) were invited to do an online survey. 1,056 individuals started the survey (response rate: 55.6%). Participants who provided data on all study variables ($N = 926$) were included in the analysis. Participants in the analytical sample tended to be young adults ($M_{age} = 23.85$, $SD_{age} = 5.82$), and 83.5% were female ($N = 773$). Participants were predominantly students (87.7%), and also included academic (6.5%) and other university staff (1.1%), and adults external to the university (3.6%). On average, $n = 11.71$ (range: 2 – 30) people per exercise class participated in the study.

Measures

Perceived instructor behavior. We used a German questionnaire to assess participants' perceptions of four dimensions of instructor behaviors: individualized and specific feedback , clear and precise instruction , care and individual consideration , and praise and encouragement (5 items in each subscale; Lohmann et al., accepted). An instructor who is perceived highly on feedback often provides specific feedback, and points out incorrect exercise performance to individuals. Instructors high in instruction give clear and precise directions about proper body positions, lead well-structured classes, and provide exercise variations and modifications. An instructor who is caring and considers individuals' needs acknowledges feelings, health status, and varying performance levels, and responds appropriately to questions and comments. Praise and encouragement refers to providing general positive comments, encouragement to endure, and communicating the aims of the exercise session. The item stem for this scale was: "Our exercise instructor…" and items included "… corrects participants individually" (individualized and specific feedback), "…describes body positions and movements clearly and vividly" (clear and precise instruction), "… appreciates the health status of individual participants and responds to possible concerns" (care and individual consideration), and "… encourages us to endure the exercise until the end" (praise and encouragement). All items are listed in the electronic supplements (ES1; validated in German language). Answers were recorded on a Likert-scale ranging from 1 = *never* to 5 = *always*.

Because this is a new instrument, we provide further information about its development and validation process, and conducted preliminary analysis of the factorial validity. The instrument was developed in a two stage process (Lohmann et al., accepted). The initial item pool was formulated based on an observational video study in the field of exercise classes (Herb & Gieß-Stüber, 2018) and previous questionnaires. Exploratory factor analyses lead to a four-factor, 20-item solution. A confirmatory factor analysis with an independent sample revealed an acceptable model fit ($\chi 2 = 308.71$, $df = 164$, $p < .01$, CFI = .92, RMSEA = .07, SRMR = .06; Lohmann et al., accepted). Further evidence was provided for the construct validity by showing that instructor behaviors predicted psychological need satisfaction and motivation.

In the present study, we conducted a multilevel confirmatory factor analysis (Muthén &

Muthén, 1998-2015) with class as a cluster variable (see ES1). The model fit was acceptable ($\chi 2 = 799.41$, $df = 146$, $p < .01$, CFI = .91, RMSEA = .07, 90% CI [.065, .074], SRMR = .07), and standardized bivariate intercorrelations between factors were moderate to high ($r = .60$ to .82). Composite reliability scores (w) were calculated for the within- and between level (Geldhof, Preacher, & Zyphur, 2014) and are reported in Table I.

Psychological need satisfaction. Satisfaction of needs for autonomy, competence, and relatedness were assessed with three items each from the German Psychological Need Satisfaction in Exercise Scale (PNSEG; Rackow, Scholz, & Hornung, 2013). The PNSEG was developed based on the original English measure (Wilson, Rogers, Rodgers, & Wild, 2006) and Greek adaptation (Vlachopoulos & Michailidou, 2006). Because the PNSEG was validated in the context of individual training, the wording of some items was adapted to specify the group exercise setting (e.g., "my exercise program" was changed to "the exercise class"). Answers were recorded on a 7-point Likert scale that ranged from 1 = *not true at all* to 7 = *completely true.* The psychometric properties of the PNSEG scale have been supported by showing good fit for the hypothesized 3-factor structure (Rackow et al., 2013) and Cronbach's alpha of the subscales in our study were all acceptable ($\alpha = .69$ - .78).

Motivation. Behavioral regulations for participating in the exercise class were assessed by the self-concordance of sport- and exercise-related goals scale (SSK; Seelig & Fuchs, 2006). This questionnaire includes scales of intrinsic motivation, identified, introjected, and extrinsic regulation. Each subscale was assessed by three items. Answers were recorded on a 6-point Likert scale from 1 = *not true at all* to 6 = *completely true.* Psychometric properties of the SSK have been supported by showing good fit for the hypothesized 4-factor structure (Seelig & Fuchs, 2006). In our study Cronbach's alpha of the subscales were all acceptable ($\alpha = .66$ - .78).

TABLE I
Descriptive Statistics And Correlations Among Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Feedback	-											
2. Instruction	.61*	-										
3. Care/Consideration	.67*	.71*	-									
4. Praise/Encouragemt.	.37*	.55*	.47*	-								
5. Autonomy	.35*	.51*	.50*	.38*	-							
6. Competence	.25*	.38*	.38*	.33*	.68*	-						
7. Relatedness	.24*	.25*	.28*	.31*	.44*	.46*	-					
8. Intrinsic motivation	.20*	.29*	.30*	.23*	.57*	.57*	.41*	-				
9. Identified regulation	.22*	.33*	.32*	.25*	.55*	.43*	.23*	.40*	-			
10. Introjected regulation	.04	-.03	-.05	.09*	-.09*	-.13*	-.01	-.16*	.09*	-		
11. External regulation	.06	-.02	.01	.03>	-.01	-.03	.12*	-.11*	.02	.37*	-	
12. Participation frequency	.07*	.04	.03	.04	.13*	.16*	.13*	.09*	.01	.02	-.04	-
M	3.72	4.23	3.70	4.17	5.64	5.68	4.58	4.94	5.18	3.17	1.48	5.67
SD	.96	.67	.80	.73	.97	.82	1.33	.90	.76	1.30	.84	.91
Scale range	1-5	1-5	1-5	1-5	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-6
Skewness	-.62	-1.17	-.50	-.98	-.88	-.69	-.19	-.91	-1.15	.18	2.54	-2.90
Kurtosis	-.46	1.36	-.17	.60	1.19	.81	-.49	.63	2.30	-.74	7.52	8.12
ICC	.44	.29	.31	.34	.08	.04	.15	.08	.03	.10	.04	.03
ω_{within}	.84+	.73+	.77+	.69+	.80−	.69+	.78+	.67+	.70+	.80+	.78+	-
$\omega_{between}$	.97+	.90+	.91+	.80+	.77+	.54+	.97+	.80+	.60+	.95+	.81+	-
α_{within}	.84+	.74+	.76+	.67+	.78+	.69+	.77+	.66+	.67+	.78+	.75+	-
$\alpha_{between}$	.96+	.89+	.89+	.80+	.78+	.51+	.93+	.76+	.62+	.90+	.82+	-

Note. *ω composite reliability, α Cronbach's alpha. $p < .05$, two-tailed; + 95% CI does not cross zero.

Participation. Participation was assessed with one item asking participants how often they attended the specific exercise class since the beginning of the semester. Answers were provided on a 6 point-Likert scale: 1 = *I didn't attend the class yet, today is my first time*, 2 = *very irregularly*, 3 = *irregularly (approximately 1 time/month)*, 4 = *every second week*, 5 = *almost every week (approximately 3 times/month)*, 6 = *every week*.

Procedures

This research was approved by the the Institutional Review Board of the first author's institution. Participants were treated in agreement with the ethical guidelines of the American Psychological Association with respect to confidentiality and anonymity. The first phase of recruitment involved participants being sent an email about the study with a link to the online survey via the administrators of the exercise facilities. Those individuals who wanted to volunteer for the study were provided with an information package when following the link. They were invited to proceed with the survey if they consented to participating. Surveys were completed anonymously. In a second phase of recruitment, trained members of the research team distributed small trail mix packets together with a business card with a printed link to the online survey attached as a reminder to complete the survey if they had not already done so. In a third phase, research team members again visited the exercise groups at the end of one class and gave a brief verbal presentation about the study, reminding those who had not yet taken part in the study to fill out the online survey if they were willing to volunteer. In this third phase, the researchers made available tablet computers for any participantss who were interested in completing the survey on site. Data collection proceeded from November to December 2016.

Data Analysis

We used SPSS 24.0 and Mplus 7.4 (Muthén & Muthén, 1998-2015) to analyze the data. Data were screened for missing values and distributional properties. Descriptive statistics and correlations were calculated for all variables. Because the data were clustered within classes (ICC = .03 - .41) and we had small clusters, we report both between-cluster alpha (recommended for small ICC's and clusters < 15) and between-cluster omega (recommended in all other conditions; Geldhof et al., 2014). Given the moderate to strong correlations among the perceived instructor behaviors (Lohmann et al., accepted) and the fact that a more complex model with four independent variables would be underidentified, we estimated four separate models with each of the four instructor behaviors as the independent variable (e.g., see Figure 2). We used multilevel structural equation modeling (MSEM; Preacher, Zyphur, & Zhang, 2010) and estimated a within-level model, accounting for the clustered data to test the hypotheses depicted in Figure 1. We examined direct pathways among all variables as an exploratory analysis, but none of those additional paths were significant, so were not included in the final models. We used maximum likelihood parameter estimates with standard errors and a χ^2 test statistic that is robust to non-normality (MLR estimator). We used manifest variables (means of all items assessing a given variable) at the within level, and latent variables to model intercepts and slopes. Because there was not significant variability in slopes between clusters, we estimated a two-level model with random intercepts and fixed slopes to improve

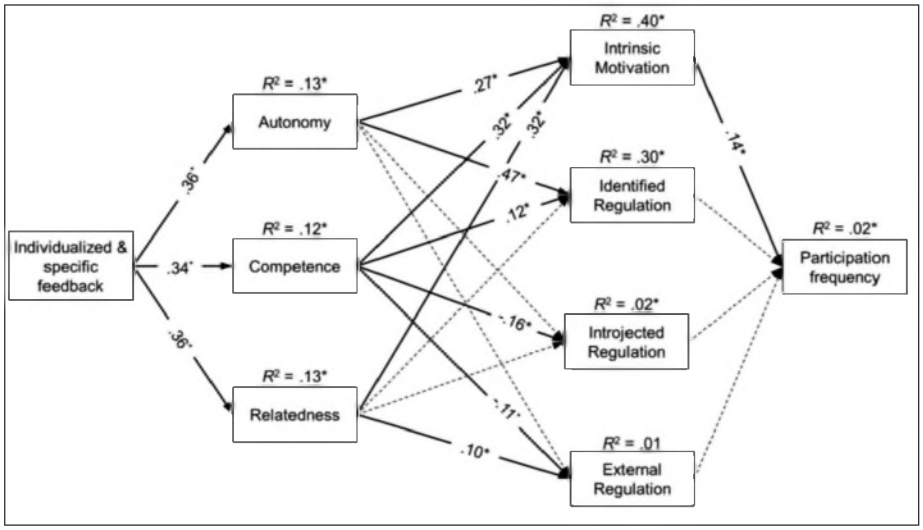

Fig. 2. - Level-1 MSEM model of the associations between perceived individualized and specific feedback, psychological need satisfaction, motivation, and participation frequency. Solid lines represent significant, dashed lines non-significant path coefficients. Standardized estimates are reported. χ^2 (25) = 66.78, p < .01, CFI = .98, RMSEA = .04, $SRMR_{within}$ = .03, $SRMR_{between}$ = .27.
* p < .05.

the parsimony of the model (Preacher et al., 2010). To test for indirect effects the delta method was used, because the bootstrap-resampling-approach (Preacher & Hayes, 2008) is not available in Mpuls for twolevel analyses (Muthén & Muthén, 1998-2015) and the delta method is considered an appropriate approach in large samples (Preacher et al., 2010). Model fit was considered acceptable if RMSEA ≤ .08, CFI ≥ .95; SRMR ≤ .08 (Kline, 2011). Perceived instructor behavior was grand mean centered.

Results

130 participants who began the survey did not provide data (n = 75) or only provided exercise participation data (n = 55) and were therefore excluded from the analysis, resulting in the analytical sample of N = 926. Those who completed the questionnaire participated more regularly in the exercise class (M = 5.67, SD = .91) than those who did not complete the survey (M = 5.22, SD = 1.56; $F(1, 979)$ = 11.71, p < .01). Because participants could only proceed with the questionnaire if all items were answered, there were no missing data in the analytical sample. The number of participants

TABLE II

Results of the multilevel structural equation modeling analysis of specific feedback predicting psychological need satisfaction, motivation, and participation frequency

Direct effects		Within			Between		
Dependent Variable	Independent Variable	β	*p*	95% CI	β	*p*	95% CI
Autonomy	Feedback	.36*	< .01	.29, .42	.66*	< .01	.45, .87
Competence	Feedback	.34*	< .01	.28, .40	.76	.10	-.16, 1.68
Relatedness	Feedback	.36*	< .01	.29, .42	-.01	.93	-.32, .29
Intrinsic motivation	Autonomy	.27*	< .01	.19, .34	1.06*	< .01	.51, 1.62
	Competence	.32*	< .01	.24, .39	-.77	.12	-1.74, .20
	Relatedness	.16*	< .01	.10, .22	.08	.66	-.27, .43
Identified regulation	Autonomy	.47*	< .01	.38, .55	.86*	< .01	.40, 1.32
	Competence	.12*	< .01	.04, .20	.15	.60	-.40, .70
	Relatedness	-.02	.55	-.08, .04	-.19	.40	.63, .25
Introjected regulation	Autonomy	.03	.57	-.07, .12	-.26	.49	-.99, .48
	Competence	-.16*	< .01	-.26, -.06	.36	.22	-.22, .93
	Relatedness	-.02	.63	-.12, .07	.56*	< .01	.22, .90
External regulation	Autonomy	.02	.59	-.05, .10	-.16	.66	-.85, .54
	Competence	-.11*	< .01	-.18, -.03	.22	.74	-1.03, 1.46
	Relatedness	.10*	.02	.01, .18	.96*	< .01	.43, 1.49
Participation frequency	Intrinsic motivation	.14*	< .01	.06, .21	-.90	.28	-2.54, .74
	Identified regulation	-.04	.29	-.13, .04	.59	.38	-.73, 1.90
	Introjected regulation	.04	.22	-.03, .11	< .01	1.00	-1.01, 1.02
	External regulation	-.06	.28	-.16, .05	.45	.41	-.61, 1.51
Indirect effects		β	*p*	95% CI	β	*p*	95% CI
FEED → AUT → INTRI		.12*	< .01	.06, .13	.21*	.02	.20, 1.20
FEED → COM → INTRI		.13*	< .01	.07, .14	-.18*	.04	-1.10, -.07
FEED → REL → INTRI		.07*	< .01	.04, .08	.00	.93	-.03, .02
FEED → AUT → IDENT		.17*	< .01	.12, .22	.11*	< .01	.29, .85
FEED → COM → IDENT		.04*	< .01	.02, .07	.02	.63	-.36, .59
FEED → REL → IDENT		-.01	.55	-.03, .02	< .01	.93	-.05, .06
FEED → AUT → INTRO		.02	.57	-.02, .04	-.11	.50	-.68, .34
FEED → COM → INTRO		-.09*	< .01	-.09, -.02	.17	.36	-.34, .88
FEED → REL → INTRO		-.01	.63	-.04, .02	-.01	.93	-.18, .16
FEED → AUT → EXTER		.01	.59	-.02, .03	-.02	.68	-.56, .36
FEED → COM → EXTER		-.04*	.01	-.06, -.01	.04	1.00	-.62, .95
FEED → REL → EXTER		.04*	.03	< .01, .07	> -.01	.93	-.30, .28
FEED → AUT → INTRI → PA		.02*	.01	<.01, .02	-.14	.21	-.97, .71
FEED → COM → INTRI → PA		.02*	.01	<.01, .03	.12	.16	-.55, 1.61
FEED → REL → INTRI → PA		.01*	< .01	<.01, .01	.00	.93	-.02, .02
FEED → AUT → IDENT → PA		-.01	.30	-.02, .01	.07	.30	-.45, 1.11
FEED → COM → IDENT → PA		> -.01	.32	-.01, <.01	.01	.64	-.24, .37
FEED → REL → IDENT → PA		.00	.58	> -.01, < .01	.00	.93	-.03, .04
FEED → AUT → INTRO → PA		< .01	.60	> -.01, < .01	.00	1.00	-.17, .17
FEED → COM → INTRO → PA		> -.01	.24	> -.01, < .01	.00	1.00	-.28, .28
FEED → REL → INTRO → PA		.00	.65	-.01, < .01	.00	1.00	-.01, .01
FEED → AUT → EXTER → PA		> -.01	.64	> -.01, < .01	-.01	.67	-.27, .18
FEED → COM → EXTER → PA		< .01	.31	> -.01, .01	.02	.70	-.31, .45
FEED → REL → EXTER → PA		> -.01	.31	-.01, < .01	> -.01	.93	-.14, .13
R^2		R^2	*SE*	*p*	R^2	*SE*	*p*
Autonomy		.13*	.02	<.01	.43*	.14	< .01
Competence		.12*	.02	< .01	.58	.71	.42
Relatedness		.13*	.02	< .01	.00	< .01	.97
Intrinsic Motivation		.40*	.04	< .01	.91	.66	.17
Identified Regulation		.30*	.03	< .01	.93*	.29	< .01
Introjected Regulation		.02*	.01	.03	.42*	.19	.03
External Regulation		.01	.01	.12	.95*	.46	.04
Participation Frequency		.02*	.01	.05	.76	.97	.43

Note. Standardized effects and CIs (delta method) are reported. *FEED* Individualized and specific feedback, *AUT* Autonomy, *COM* Competence, *REL* Relatedness, *INTRI* Intrinsic motivation, *IDENT* Identified regulation, *INTRO* Introjected regulation, EXTER External regulation, *PA* Participation frequency.

from each exercise class ranged from 2 to 30. All participants were retained in the analysis because even small clusters contribute to the estimation of between-level parameters, and the accuracy of level-1 (participant) predictors is not impacted (Bell, Ferron, & Kromrey, 2008). Other than slightly elevated skew and kurtosis values for external regulation and exercise participation, the data were approximately normally distributed. Given the small deviation from normality, the large sample, and the use of robust estimators, we proceeded with the analyses without modification (Miles & Shevlin, 2001).

Descriptive values and correlations are displayed in Table 1. Participants generally rated their instructors as high in all four dimensions (M = 3.81 – 4.23). Most participants (87%) attended their exercise class weekly (M = 5.67). Significant positive correlations were found among all instructor variables, all three needs, intrinsic motivation, and identified regulation. Instructor behaviors generally did not correlate significantly with introjected and external regulation, except a positive association between praise and encouragement and introjected regulation. The only subscale of perceived instructor behavior that correlated significantly with exercise participation was individualized and specific feedback.

The absolute effect of instructor behavior was estimated in four models, with each of the four instructor behaviors as the independent variable (e.g., see Figure 2). The fit indices of all four models were acceptable: χ^2 = 51.40 – 96.64, df = 25, p < .01, RMSEA .03-.06, CFI = .97-.99, $SRMR_{within}$ = .03, $SRMR_{between}$ = .22-.29 (see ES2). At level 1 (participant level), the four models had the same pattern and direction of significant and nonsignificant paths, the point estimates only slightly varied between the models. Therefore, for brevity, only the structural model for individualized and specific feedback is depicted in Figure 2 and Table 2. Detailed results for all models are presented in the electronic supplementary files (ES3-5). Consistent with our hypotheses, we found positive direct effects between each perceived instructor behavior and autonomy (b = .36-.52, p < .01), competence (b = .34-.44, p < .01), and relatedness (b = .30-.40, p < .01). Furthermore, all three needs predicted intrinsic motivation (autonomy: b = .26-.27, competence: b = .32, relatedness: b = .16, all p < .01), and there was a direct positive association between intrinsic motivation and participation frequency (b = .13-.14, p < .01).

The mediation hypothesis was supported for the association between each perceived instructor behavior and participation via all three needs and intrinsic motivation. There were small but significant indirect effects from perceived instructor behavior on participation, via each of the three needs

(autonomy: β = .02; competence: β = .02; relatedness: β = .01; $p < .05$) and via intrinsic motivation. There were no significant indirect effects via identified, introjected or extrinsic regulation. The four models explained a reasonable amount of variance in autonomy ($R^2 = .13$-$.27$, $p < .01$), competence ($R^2 = .12$-$.20$, $p < .01$), and relatedness ($R^2 = .09$-$.16$, $p < .01$) need satisfaction; intrinsic motivation ($R^2 = .40$, $p < .01$), identified regulation ($R^2 = .30$, $p < .01$), and introjected regulation ($R^2 = .02$, $p = .03$), but less in external regulation ($R^2 = .01$, p = .12-.24); and participation frequency ($R^2 = .02$, p = .05-.09).

Although the hypotheses concerned the within-cluster results, between-cluster results suggest that feedback at the class-level had a positive indirect effect on intrinsic motivation (ß = .21, $p = .02$) and identified regulation (ß = .11, $p < .01$) via autonomy need satisfaction .There was a negative indirect effect of perceived feedback on intrinsic motivation via competence need satisfaction (ß = -.18, $p = .04$). For controlled motivation, relatedness need satisfaction within the class positively predicted introjected (ß = .56, $p < .01$) and extrinsic regulation (ß = .96, $p < .01$).

Discussion

The aim of this study was to examine associations between perceived instructor behaviors, psychological need satisfaction, motivation, and participation frequency, and the mediational role of psychological need satisfaction and behavioral regulations among adults in university-based exercise programs. The first hypothesis was supported in that greater use of four key instructor behaviors predicted greater psychological need satisfaction, autonomous motivation, and participation frequency. The second hypothesis was partially supported in that all three psychological needs, and intrinsic motivation (but not the other forms of behavioral regulation), mediated the instructor behavior-participation association. This means that an effective way to foster intrinsic motivation and participation in exercise classes may be to facilitate psychological need satisfaction through the provision of individualized and specific feedback, clear and precise instruction, care and individual consideration as well as praise and encouragement.

Although the effect size was small, we found that individualized and specific feedback was positively associated with attending classes regularly. This is an interesting finding because an observational study in similar group exercise classes showed that instructors only spend up to 10% of the class time providing individualized and specific feedback (Herb & Gieß-Stüber, 2018). To date there are no studies that systematically investigated the effect of per-

ceived feedback on motivation and exercise participation in exercise classes. Specific feedback usually is included in the theoretical conceptualization of a need supportive motivational climate (Hancox et al., 2017; Quested et al, 2018). Regarding the small effect size, our results are consistent with other studies that used self-report measures to assess exercise participation and did not find direct effects of perceived need supportive climate on participation (Edmunds et al., 2008; Kinnafick et al., 2014; Markland & Tobin, 2010). Perceived instructor behavior is a rather distal determinant of exercise behavior and therefore effect sizes might not be expected to be as high as those for more proximal variables like need satisfaction or motivation.

Although the participation variable was not substantively skewed, 90% of participants indicated that they participate in the exercise classes on a regular basis, and might therefore be considered as "adherers" who are more likely to experience intrinsic motivation (Teixeira et al., 2012). Extrinsic regulations might play a more important role for exercise participation among individuals who participate in exercise classes because of health problems, pain, or body image (Ingledew & Markland, 2008) and the internalization process might be more difficult for them. Further research is needed to explore the mediating effects of the behavioral regulations among exercise novices or individuals who are susceptible to drop out or less frequent participation as extrinsic regulations might play a different role for these populations.

In contrast to many previous studies we included three psychological needs and four behavioral regulations as separate variables in one model and could thus estimate differential effects (Brunet, Gunnell, Teixeira, Sabiston, & Belanger, 2016). Similar effects were found for all three needs in predicting intrinsic motivation, but mixed results were found for controlled forms of motivation. Whereas competence and autonomy need satisfaction were associated with adaptive motivational outcomes (more autonomous, less controlled motivation), the role of relatedness was more ambivalent. In contrast to previous studies (Davies et al., 2016; McDonough & Crocker, 2007), we found a positive effect of relatedness need satisfaction on external regulation. Feeling socially connected may both be associated with enhanced pleasure and satisfaction (intrinsic motivation) in physical activity (Rahman, Hudson, Thøgersen-Ntoumani, & Doust, 2015), but access to that connection via physical activity participation may also be experienced in part as an externally administered reward (external regulation). Qualitative studies have highlighted the importance of social relationships within the exercise context (Estabrooks et al., 2004), but quantitative studies have not yet investigated the role of the need for relatedness exhaustively (Teixeira et al., 2012). There-

fore, future studies should further explore the role of relationships among exercise class participants and with instructors and how they inform motivational processes.

Limitations

High correlations among the perceived instructor behaviors precluded assessing the relative contribution of these behaviors. The perceived instructor behaviors assessed were more useful for predicting autonomous versus controlled motivation. Furthermore, the instructor behavior measure was more focused on competence and relatedness, and relatively less on autonomy because within structured exercise classes, participants may expect more of these behaviors than support for their need for autonomy. A broader range of instructor behaviors including need supporting, need thwarting, and indifferent behaviors may be fruitful to include in future studies (e.g., Quested et al., 2018), based on relevance within the given context. The cross-sectional design precludes drawing causal conclusions about mediation. The use of a self-report measure for participation may lead to a biased estimate of exercise behavior. In our study we could not obtain attendance records for assessing exercise participation because of organizational restrictions within the field. If these can be overcome, more objective and/or concurrent self-report measures should be used. Sampling mostly university students participating in exercise classes offered at their institution limited the generalizability to those in this population who are active exercisers, as shown by the high rates of exercise participation in the sample. Sampling the university campus population more broadly would improve generalizability, as it is known that some university students struggle with exercise adherence in the transition to adulthood.

Conclusion

Support for the mediation hypothesis within a SDT-framework was reported: indirect effects of each instructor behavior on participation frequency via the three psychological needs and intrinsic motivation were empirically confirmed. However, none of the other behavioral regulations mediated this association. It is important to look at the independent contribution of the psychological needs and behavioral regulations to the prediction of exercise behaviors as they might lead to different behavioral, emo-

tional and affective outcomes and may be affected differently by antecedents such as perceived instructor behavior. These findings underline the importance of individual and specific feedback, clear and precise instruction, care and individual consideration, and praise and encouragement as context specific instructor behaviors for motivational processes in group exercise classes, and they emphasize the role of fostering intrinsic motivation for the promotion of exercise behavior.

What does this article add?

Based on the well-established SDT-framework we conducted a context specific analysis of perceived instructor behaviors and their effects on psychological need satisfaction, behavioral regulation, and participation in group exercise classes. Practical implications are drawn from this stuy in terms of qualifying exercise instructors and sensitizing them for the facilitation of psychological need satisfaction and intrinsic motivation. More generally, public health may benefit from a better understanding of motivational processes within group exercise and the effects of specific instructor behaviors. The motivational (mediation) sequence instructor behavior → psychological need satisfaction → motivation → exercise participation was empirically confirmed. Instructors may facilitate exercise participation through purposefully providing individualized and specific feedback, clear and precise instruction, care and individual consideration and praise and encouragement – but they should be aware that fostering relatedness in participants might be associated with external control, possibly depending on how it is *enacted.*

Electronic Supplement ES1

ES1
Results of the multilevel confirmatory factor analysis for the perceived instructor behavior scale. English items are not validated.

Our instructor…	*M*	*SD*	*β*	*p*
(1) Individualized and precise feedback				
… walks and stands nearby individual participants to address them.	3.88	1.11	.89	< .01
… corrects participants individually.	3.84	1.18	.94	< .01
… tells us if we make mistakes or perform wrongly.	4.06	1.01	.82	< .01
… gives specific feedback and tells us exactly what we did or did not well.	3.46	1.09	.69	< .01
… corrects participants by direct contact.	3.36	1.31	.69	< .01
(2) Clear and precise instruction				
… explains exercises precisely so that we know exactly how to perform and how it should feel.	4.48	.73	.75	< .01
… leads the class clearly and with structure.	4.52	.73	.70	< .01
… provides us with the adequate time to perform exercise intensively and at our own pace	4.00	1.08	.64	< .01
… describes body positions and movements clearly and vividly.	4.48	.78	.78	< .01
… provides us with assistive devices if we need them to vary exercises.	3.69	1.19	.57	< .01
(3) Care and individual consideration				
… appreciates the health status of individual participants and responds to possible concerns.	3.73	1.19	.76	< .01
… puts him or herself in the position of individuals.	3.78	.98	.75	< .01
… takes the different performance levels of all participants into consideration.	3.97	1.01	.71	< .01
… reacts adequately to all questions and comments.	4.35	.82	.59	< .01
… provides us information for individual exercise at home or at the fitness studio.	2.66	1.29	.59	< .01
(4) Praise and encouragement				
… praises the whole group.	4.38	.90	.70	< .01
… tells us in the beginning of the class what we have to expect.	3.79	1.23	.52	< .01
… encourages us to endure the exercise until the end.	4.45	.88	.54	< .01
… provides overall positive feedback and encourages us generally.	4.07	.94	.81	< .01

Note. Model Fit: $\chi 2 = 799.41$, $df = 146$, $p < .01$, CFI = .91, RMSEA = .07, 90% CI [.065, .074], SRMR = .07

Electronic Supplement ES2

ES2
Model fit statistics for estimated models

Model	χ^2	*df*	*p*	RMSEA	CFI	$SRMR_{within}$	$SRMR_{between}$
1. Feedback	66.78	25	< .01	.04	.98	.03	.27
2. Instruction	51.40	25	< .01	.03	.99	.03	.26
3. Care/Consideration	63.56	25	< .01	.04	.98	.03	.29
4. Praise/Encouragemt.	96.64	25	< .01	.06	.97	.03	.22

Electronic Supplement ES3

ES3
Results of the multilevel structural equation modeling mediation analysis of effects of perceived clear and precise instruction on participation frequency.

Direct effects			Within			Between	
Dependent Variable	Independent Variable	β	*p*	95% CI	β	*p*	95% CI
Autonomy	Instruction	.52*	< .01	.45, .58	.07	.06	-.02, 1.46
Competence	Instruction	.44*	< .01	.35, .52	.84	.83	-6.85, 8.54
Relatedness	Instruction	.32*	< .01	.24, .39	-.09	.88	-1.20, 1.03
Intrinsic motivation	Autonomy	.27*	< .01.	.18, .35	1.14*	.05	.03, 2.25
	Competence	.32*	< .01	.19, .45	-.79	.84	-8.50, 6.92
	Relatedness	.16*	< .01	.06, .03	.06	.94	-1.47, 1.59
Identified regulation	Autonomy	.47*	< .01	.9, .55	.87	.41	-1.22, 2.96
	Competence	.12*	< .01	.04, .20	.05	.97	-3.28, 3.39
	Relatedness	-.02	.54	-.08, .04	-.17	.46	-.62, .28
Introjected regulation	Autonomy	.03	.70	-.11, .17	-.29	.88	-3.92, 3.54
	Competence	-.16*	< .01	-.26, -.06	.38	.59	-1.00, 1.75
	Relatedness	-.02	.70	-.14, .09	.58	.10	-.12, 1.27
External regulation	Autonomy	.02	.65	-.07, .12	-.14	.96	-5.56, 5.29
	Competence	-.11*	.03	-.20, -.01	.14	.98	-10.89, 11.16
	Relatedness	.10	.06	-.01, .20	.96	.11	-.21, 2.13
Participation frequency	Intrinsic motivation	.13*	.01	.02, .24	-.85	.82	-8.23, 6.52
	Identified regulation	-.04	.32	-.12, .04	.53	.86	-5.20, 6.25
	Introjected regulation	.04	.30	-.04, .12	.06	.96	-2.20, 2.32
	External regulation	-.05	.39	-.18, .07	.38	.44	-.58, 1.33
Indirect effects		β	*p*	95% CI	β	*p*	95% CI
INSTR → AUT → INTRI		.14*	< .01	.09, .18	.82	.31	-.76, 2.40
INSTR → COM → INTRI		.14*	< .01	.06, .22	-.67	.10	-1.45, .12
INSTR → REL → INTRI		.05*	< .01	.02, .08	-.01	.96	-.20, .19
INSTR → AUT → IDENT		.24*	< .01	.19, .30	.63	.56	-1.49, 2.75
INSTR → COM → IDENT		.05*	< .01	.02, .09	.05	.97	-2.35, 2.44
INSTR → REL → IDENT		-.01	.53	-.02, .01	.02	.89	-.19, .22
INSTR → AUT → INTRO		.01	.70	-.06, .09	-.21	.89	-3.03, 2.62
INSTR → COM → INTRO		-.07*	< .01	-.11, -.02	.32	.75	-1.61, 2.25
INSTR → REL → INTRO		-.01	.70	-.04, .03	-.05	.87	-.65, .55
INSTR → AUT → EXTER		.01	.66	-.04, .06	-.10	.96	-3.91, 3.72
INSTR → COM → EXTER		-.05*	.04	-.09, > -.01	.12	.98	-8.10, 8.34
INSTR → REL → EXTER		.03	.09	-.01, .07	-.08	.87	-1.07, .90
INSTR → AUT → INTRI → PA		.02*	.02	< .01, .03	-.70	.85	-7.95, 6.55
INSTR → COM → INTRI → PA		.02*	.01	.01, .03	.57	.81	-3.99, 5.13
INSTR → REL → INTRI → PA		.01	.09	> -.01, .02	< .01	.95	-.13, .13
INSTR → AUT → IDENT → PA		-.01	.32	-.03, .01	.33	.89	-4.37, 5.03
INSTR → COM → IDENT → PA		> -.01	.35	-.01, < .01	.02	.96	-.99, 1.04
INSTR → REL → IDENT → PA		.00	.57	> -.01, < .01	.01	.72	-.04, .05
INSTR → AUT → INTRO → PA		< .01	.75	> -.01, < .01	-.01	.97	-.65, .62
INSTR → COM → INTRO → PA		> -.01	.33	-.01, < .01	.02	.96	-.81, .85
INSTR → REL → INTRO → PA		.00	.74	> -.01, < .01	> -.01	.94	-.08, .08
INSTR → AUT → EXTER → PA		> -.01	.73	> -.01, < .01	-.04	.96	-1.50, 1.43
INSTR → COM → EXTER → PA		< .01	.49	-.01, .01	.04	.98	-3.09, 3.17
INSTR → REL → EXTER → PA		> -.01	.50	-.01, < .01	-.03	.88	-.44, .38
R^2		R^2	*SE*	*p*	R^2	*SE*	*p*
Autonomy		.27*	.03	< .01	.52	.54	.34
Competence		.19*	.04	< .01	.71	6.61	.92
Relatedness		.10*	.03	< .01	.01	.10	.94
Intrinsic Motivation		.40*	.04	< .01	.83	5.92	.89
Identified Regulation		.30*	.03	< .01	.87*	.28	< .01
Introjected Regulation		.02*	.01	.03	.41	.31	.19
External Regulation		.01	.01	.24	.94	.60	.12
Participation Frequency		.02	.01	.09	.62	.50	.62

Note. Standardized effects and CIs (delta method) are reported. *INSTR* Clear and precise instruction, *AUT* Autonomy, *COM* Competence, *REL* Relatedness, *INTRI* Intrinsic motivation, *IDENT* Identified regulation, *INTRO* Introjected regulation, *EXTER* External regulation, *PA* Participation frequency. * $p <$ .05, $^+$ CI does not cross zero.

Electronic Supplement ES4

ES4
Results of the multilevel structural equation modeling mediation analysis of effects of perceived care and individual consideration on participation frequency.

Direct effects		Within			Between		
Dependent Variable	Independent Variable	β	*p*	95% CI	β	*p*	95% CI
Autonomy	Care/Consideration	.51*	< .01	.63, .80	.75*	< .01	.13, .51
Competence	Care/Consideration	.45*	< .01	.46, .64	.74	.07	-.02, .10
Relatedness	Care/Consideration	.40*	< .01	.62, .83	-.23	.26	-.60, .16
Intrinsic motivation	Autonomy	.27*	< .01	.18, .32	1.10*	.01	.06, 1.99
	Competence	.32*	< .01	.25, .42	-.89	.06	-16.11, 2.96
	Relatedness	.16*	< .01	.07, .16	.04	.86	-.16, .19
Identified regulation	Autonomy	.47*	< .01	.30, .44	.82*	< .01	.20, .83
	Competence	.12 *	< .01	.04, .18	.14	.65	-2.36, 3.79
	Relatedness	-.02	.54	-.05, .03	-.15	.53	-.17, .08
Introjected regulation	Autonomy	.03	.54	-.09, .16	-.25	.45	-1.69, .73
	Competence	-.16*	< .01	-.38, -.09	.30	.29	-4.19, 13.53
	Relatedness	-.02	.62	-.12, .07	.58*	< .01	.12, .97
External regulation	Autonomy	.02	.64	-.05, .08	-.13	.71	-.65, .45
	Competence	-.11*	< .01	-.18, -.03	.32	.56	-5.13, 8.96
	Relatedness	.10*	.02	.01, .12	.97*	< .01	.22, .46
Participation frequency	Intrinsic motivation	.13*	< .01	.06, .22	-.63	.26	-1.18, .25
	Identified regulation	-.04	.35	-.15, .05	.20	.64	-.61, 1.05
	Introjected regulation	.04	.23	-.02, .08	.13	.77	-.28, .38
	External regulation	-.06	.28	-.17, .05	.25	.55	-.51, .97
Indirect effects		β	*p*	95% CI	β	*p*	95% CI
CARE → AUT → INTRI		.14*	< .01	.09, .18	.83*	.05	.02, 1.63
CARE → COM → INTRI		.14*	< .01	.10, .18	-.66	.13	-1.51, .19
CARE → REL → INTRI		.06*	< .01	.04, .09	-.01	.85	-.09, .08
CARE → AUT → IDENT		.24*	< .01	.19, .29	.62*	< .01	.32, .91
CARE → COM → IDENT		.05*	< .01	.02, .09	.11	.68	-.39, .61
CARE → REL → IDENT		-.01	.53	-.03, 02	.03	.55	-.08, .14
CARE → AUT → INTRO		.02	.54	-.03, .06	-.18	.48	-.69, .33
CARE → COM → INTRO		-.07*	< .01	-.12, -.03	.22	.37	-.26, .70
CARE → REL → INTRO		-.01	.62	-.05, .03	-.13	.34	-.40, .14
CARE → AUT → EXTER		.01	.64	-.03, .05	-.10	.71	-.62, .43
CARE → COM → EXTER		-.05*	< .01	-.08, -.02	.24	.51	-.47, .95
CARE → REL → EXTER		.04*	.02	.01, .07	-.22	.30	-.63, .19
CARE → AUT → INTRI → PA		.02*	< .01	.01, .03	-.52	.32	-1.53, .49
CARE → COM → INTRI → PA		.02*	.01	.01, .03	.41	.31	-.38, 1.21
CARE → REL → INTRI → PA		.01*	< .01	< .01, .01	.01	.86	-.05, .06
CARE → AUT → IDENT → PA		-.01	.35	-.03, .01	.13	.64	-.40, .65
CARE → COM → IDENT → PA		> -.01	.37	-.01, < .01	.02	.71	-.09, .14
CARE → REL → IDENT → PA		.00	.58	> -.01, < .01	.01	.72	-.03, .04
CARE → AUT → INTRO → PA		< .01	.59	> -.01, < .01	-.02	.81	-.23, .18
CARE → COM → INTRO → PA		> -.01	.25	-.01, < .01	.03	.80	-.20, .26
CARE → REL → INTRO → PA		.00	.65	> -.01, < .01	-.02	.78	-.14, .10
CARE → AUT → EXTER → PA		.00	.68	> -.01, < .01	-.03	.72	-.16, .11
CARE → COM → EXTER → PA		< .01	.30	> -.01, .01	.06	.63	-.18, .30
CARE → REL → EXTER → PA		> -.01	.31	-.01, < .01	-.06	.62	-.27, .16
R^2		R^2	*SE*	*p*	R^2	*SE*	*p*
Autonomy		.26*	.03	< .01	.56*	.16	< .01
Competence		.20*	.03	< .01	.54	.60	.36
Relatedness		.16*	.02	< .01	.05	.09	.58
Intrinsic Motivation		.40*	.04	<.01	.92	.61	.13
Identified Regulation		.30*	.03	< .01	.90*	.31	< .01
Introjected Regulation		.02*	.01	.03	.40*	.18	.03
External Regulation		.01	.01	.12	.96*	.45	.03
Participation Frequency		.02	.01	.06	.50	.57	.38

Note. Standardized effects and CIs (delta method) are reported. *CARE* Care and individual consideration, *AUT* Autonomy, *COM* Competence, *REL* Relatedness, *INTRI* Intrinsic motivation, *IDENT* Identified regulation, *INTRO* Introjected regulation, *EXTER* External regulation, *PA* Participation frequency. * $p < .05$.

Electronic Supplement ES5

ES5
Results of the multilevel structural equation modeling mediation analysis of effects of perceived praise and encouragement on participation frequency.

Direct effects		Within			Between		
Dependent Variable	Independent Variable	β	*p*	95% CI	β	*p*	95% CI
Autonomy	Praise/Encouragem.	.44*	< .01	.38, .50	.23	.38	-.27, .73
Competence	Praise/Encouragem.	.37*	< .01	.30, .43	.91*	.02	.16, 1.66
Relatedness	Praise/Encouragem.	.30*	< .01	.24, .36	.40*	.03	.04, .76
Intrinsic motivation	Autonomy	.26*	< .01	.18, .34	.74	.04	.04, 1.43
	Competence	.32*	< .01	.24, .40	-.13	.67	-.73, .47
	Relatedness	.16 *	< .01	.11, .22	.11	.70	-.45, .67
Identified regulation	Autonomy	.47*	< .01	.38, .55	.94*	< .01	.54, 1.33
	Competence	.12*	< .01	.04, .20	.05	.87	-.57, .68
	Relatedness	-.02	.58	-.08, .05	-.25	.50	-.98, .48
Introjected regulation	Autonomy	.03	.54	-.06, .12	-.14	.61	-.66, .39
	Competence	-.16*	< .01	-.26, -.07	.64*	.05	< .01, 1.27
	Relatedness	-.02	.65	-.11, .07	.37	.11	-.08, .82
External regulation	Autonomy	.02	.64	-.06, .10	-.03	.92	-.50, .45
	Competence	-.11*	< .01	-.18, -.03	.04	.92	-.74, .82
	Relatedness	.10*	.02	.01, .18	.95	< .01	.39, 1.50
Participation frequency	Intrinsic motivation	.13*	< .01	..06, .21	-1.07	.46	-3.89, 1.74
	Identified regulation	-.02	.29	-.13, .04	.85	.54	-1.84, 3.54
	Introjected regulation	.03	.32	-.03, .10	.32	.76	-1.70, 2.35
	External regulation	-.05	.32	-.16, .05	.40	.77	-2.26, 3.05

Indirect effects	β	*p*	95% CI	β	*p*	95% CI
PRAISE → AUT → INTRI	.12*	< .01	.08, .16	.17	.48	-.29, .63
PRAISE → COM → INTRI	.12*	< .01	.08, .15	-.12	.68	-.68, .45
PRAISE → REL → INTRI	.05*	< .01	.03, .07	.04	.70	-.18, .27
PRAISE → AUT → IDENT	.21*	< .01	.16, .25	.21	.42	-.30, .72
PRAISE → COM → IDENT	.04*	.01	.01, .08	.05	.86	-.50, .60
PRAISE → REL → IDENT	-.01	.58	-.02, .01	-.10	.55	-.42, .22
PRAISE → AUT → INTRO	.01	.53	-.03, .05	-.03	.71	-.19, .13
PRAISE → COM → INTRO	-.06*	< .01	-.10, -.02	.58*	.01	.17, .98
PRAISE → REL → INTRO	-.01	.65	-.03, .02	.15	.17	-.06, .36
PRAISE → AUT → EXTER	.01	.64	-.03, .04	-.01	.92	-.12, .10
PRAISE → COM → EXTER	-.04*	.01	-.07, -.01	.04	.92	-.68, .75
PRAISE → REL → EXTER	.03*	.03	< .01, .05	.38	.13	-.11, .86
PRAISE → AUT → INTRI → PA	.02*	< .01	.01, .03	-.18	.68	-1.01, .66
PRAISE → COM → INTRI → PA	.02*	< .01	.01, .03	.13	.78	-.76, 1.01
PRAISE → REL → INTRI → PA	.01*	< .01	< .01, .01	-.05	.79	-.38, .29
PRAISE → AUT → IDENT → PA	-.01	.29	-.03, .01	.18	.67	-.66, 1.02
PRAISE → COM → IDENT → PA	> -.01	.31	-.01, < .01	.04	.88	-.50, .58
PRAISE → REL → IDENT → PA	.00	.60	> -.01, < .01	-.09	.73	-.57, .40
PRAISE → AUT → INTRO → PA	.00	.60	> -.01, < .01	-.01	.80	-.09, .07
PRAISE → COM → INTRO → PA	> -.01	.33	-.01, < .01	.19	.77	-1.04, 1.42
PRAISE → REL → INTRO → PA	.00	.68	> -.01, < .01	.05	.78	-.29, .38
PRAISE → AUT → EXTER → PA	.00	.69	> -.01, < .01	> -.01	.94	-.06, .05
PRAISE → COM → EXTER → PA	< .01	.35	> -.01, .01	.01	.94	-.35, .38
PRAISE → REL → EXTER → PA	> -.01	.35	-.01, < .01	.15	.78	-.88, 1.18

R^2	R^2	*SE*	*p*	R^2	*SE*	*p*
Autonomy	.19*	.03	< .01	.05	.12	.66
Competence	.13*	.02	< .01	.83	.69	.24
Relatedness	.09*	.02	< .01	.16	.15	.28
Intrinsic Motivation	.40*	.04	< .01	.54	.52	.30
Identified Regulation	.30*	.03	< .01	.91*	.44	.04
Introjected Regulation	.02*	.01	.03	.69	.47	.15
External Regulation	.01	.01	.12	.92	.52	.08
Participation Frequency	.02	.01	.06	.87	1.02	.39

Note. Standardized effects and CIs (delta method) are reported. *PRAISE* Praise and Encouragement, *AUT* Autonomy, *COM* Competence, *REL* Relatedness, *INTRI* Intrinsic motivation, *IDENT* Identified regulation, *INTRO* Introjected regulation, *EXTER* External regulation, *PA* Participation frequency. * $p < .05$.

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