

The roles of need-supportive social environments in university physical education courses

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Chu, T. L., Zhang, T., & Cheung, H. Y. (2019). The roles of need-supportive social environments in university physical education courses. *International Journal of Sport and Exercise Psychology*, 17(3), 212–231. DOI: 10.1080/1612197X.2017.1339727

This is an Accepted Manuscript of an article published by Taylor & Francis in the *International Journal of Sport and Exercise Psychology* on June 20th, 2017, available at: <https://doi.org/10.1080/1612197X.2017.1339727>.



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Abstract:

It is well documented that the physical activity levels of young adults have declined below the recommended guidelines on health. Since positive experiences in physical education (PE) could influence individuals to adopt physically active lifestyles, studying different motivation types (motivational regulations) in university PE is warranted. Guided by the self-determination theory (SDT), the main purpose of the present study was to investigate the differential relationships among social environments (i.e. autonomy support, self-reference, and cooperative learning), basic psychological needs (i.e. autonomy, competence, and relatedness), and motivational regulations in university PE courses. Hong Kong university students (N=219) aged 18–26 completed questionnaires that assessed the SDT variables in PE and exercise behaviours. Multiple mediation analyses showed that all three social environments had positive indirect effects on intrinsic motivation and identified regulation through all three psychological needs, except for indirect effects of autonomy support through autonomy. Moreover, autonomy support had a positive indirect effect on introjected regulation through relatedness, and cooperative learning had a negative indirect effect on amotivation through autonomy. Overall, relatedness was the strongest mediator. Finally, intrinsic motivation and identified regulation were positively associated with enjoyment and intention for future participation in the PE activity. The results are consistent with SDT assumptions and expand the literature on the differential effects of social environments on motivational regulations in university PE. Implications on teaching strategies and future studies are discussed.

Keywords: motivational regulations | physical education | university students | social environments | multiple mediation

Article:

Introduction

Although the benefits of regular physical activity (PA) are clear, ample evidence has revealed a decline in PA participation during the transition from high school to university worldwide (e.g.

Deforche, Van Dyck, Deliëns, & De Bourdeaudhuij, Citation2015; Duan et al., Citation2015). Only 10.5% and 23.3% of the university students in Hong Kong reported achieving the recommended 150 minutes of moderate PA and 60 minutes of vigorous PA per week, respectively (Seo et al., Citation2014). To reverse this trend and promote physically active lifestyles, positive PA experience throughout university studies is important. Although physical education (PE) can enhance students' in-class and leisure-time PA through enjoyment in participation (Jaakkola, Yli-Piipari, Barkoukis, & Liukkonen, Citation2017), PE is not mandatory in university education across countries (Leslie, Sparling, & Owen, Citation2001). But fortunately, most universities worldwide offer optional PE courses in which students can develop lifelong PA (Leslie et al., Citation2001). In Hong Kong, "PE courses are organized with the aim to enable students acquire new sports skills and foster their lifelong pursuit in sports" (City University of Hong Kong, Citationn.d.), consisting of a variety of sports and PAs. They are mostly designed for general students to gain skills in a sport or PA that they have not learnt before so as to increase their overall PA participation. As the number of students enrolled in universities worldwide is expected to double to 262 million by 2025 (Maslen, Citation2012), university PE courses will become even more important for PA promotion. These findings urge us to understand the motivational processes of university PE participation in order to effectively promote PA and health among young adults.

Self-determination and motivational regulations

Self-determination theory (SDT; Deci & Ryan, Citation1985, Citation2000) has been widely applied to examine motivation in PA and educational settings. According to SDT, behaviour can be explained by self-determination in a continuum composed of intrinsic motivation, extrinsic motivation, and amotivation. Self-determination can be defined as the process by which a person controls and regulates actions in a particular context (Deci & Ryan, Citation1985). The higher the self-determination is, the greater is the energy and drive to do an activity. The prototype of the self-determination continuum is intrinsic motivation, a motivation type driven by interest or enjoyment and exists within the individual rather than by external pressures or reward (Deci & Ryan, Citation1985).

People who are extrinsically motivated perform an activity with aims to achieve separable outcomes (Ryan & Deci, Citation2000). Extrinsic motivation is multidimensional and exists in four forms with varied degrees of internalisation: integrated, identified, introjected, and external regulations. Integrated regulation Footnote1 is the most internalised form of extrinsic motivation in the self-determination continuum. Individuals in this form engage in regular PA for consistency with their identity and core values of being a healthy person. Identified regulation is the next motivational regulation in the continuum. Individuals in this category choose to participate in an activity because they begin to value its importance. Introjected motivation is partially internalised, but the action is still linked to external reasons, such as guilt or obligation rather than free choice (Deci & Ryan, Citation1985). External regulation is the least internalised form of extrinsic motivation in the continuum. Actions are spurred by rewards or avoidance of punishment, such as playing sports only for scholarship requirements. These extrinsic motivation forms explain the reasons why people participate in activities voluntarily without intrinsic motivation (Ryan & Deci, Citation2000). The last motivation type in the self-determination continuum is amotivation, an absence of motivation (Ryan & Deci, Citation2000). An amotivated person has neither desire nor intention for a particular behaviour. Motivational regulations, categorised as self-determined motivation (i.e. intrinsic motivation, integrated, and identified regulations) and non-self-

determined motivation (i.e. introjected and external regulations, amotivation), are significant antecedents of adaptive/maladaptive behaviours and well-/ill-being in sports, exercise, and educational contexts (Deci & Ryan, Citation2000).

Basic psychological needs and social environments

SDT proposes three basic psychological needs that represent essential elements for ongoing psychological growth and integrity (Deci & Ryan, Citation2000). The need for autonomy refers to experiencing choice and responsibility for one's own actions. Competence refers to a sense of control in producing predictable outcomes to interact effectively with the environment. Relatedness refers to a sense of belonging in a social environment and connection with others. Greater satisfaction of these needs leads to higher self-determination (Ryan & Deci, Citation2000). Yet, the three needs have differential effects on motivational regulations. Specifically, satisfying autonomy is necessary for full internalisation and intrinsic motivation, while satisfying competence and relatedness leads to partial internalisation (Deci & Ryan, Citation2000). Thus, unique patterns of intrinsic, identified, and introjected regulations result from satisfying different psychological needs. Koestner and Losier (Citation2002) proposed that autonomy is central and competence is important to self-determined motivation, but that relatedness only facilitates introjected and identified regulations. A systematic review of 66 articles based on SDT provides consistent support for competence, identified regulation, and intrinsic motivation in predicting PA participation; yet, the roles of autonomy, relatedness, and external and introjected regulations are mixed (Teixeira, Carraça, Markland, Silva, & Ryan, Citation2012). The mediating effects of the psychological needs on various motivational regulations should be studied to further understanding of the motivational sequence.

Optimal social environments are important to satisfy the psychological needs as well as facilitate self-determination and behavioural engagement (Ryan & Deci, Citation2000). Vallerand (Citation1997) proposed a hierarchical motivational model sequence of “social factors, psychological mediators, types of motivation, consequences” to study motivation. This model has also been applied to PE and PA contexts across primary (Leptokaridou, Vlachopoulos, & Papaioannou, Citation2015), secondary (Ntoumanis, Citation2001; Standage, Duda, & Ntoumanis, Citation2003), and tertiary education (Edmunds, Ntoumanis, & Duda, Citation2008; Puente & Anshel, Citation2010), where important social factors include learning environments established by instructors. The present study examined the social environments in terms of choice, improvement, and cooperation. Autonomy support is a social environment focusing on choices in which instructors exhibit behaviours that increase students' feelings of control (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, Citation2005). This perceived internal control can satisfy the three psychological needs and promote intrinsic motivation (Ryan & Deci, Citation2000). Self-reference is another social environment in which student achievements are evaluated based on improvement. It fosters perceived competence in PE settings by promoting mastery instead of interpersonal comparison (Kavussanu & Roberts, Citation1996), facilitates autonomy by determining success based on controllable efforts, and enhances relatedness by reducing social conflicts from comparative criteria (Ntoumanis, Citation2001). Cooperative learning is a student-centred environment in which learning activities offer students chances to interact and make decisions as a group (Dyson, Griffin, & Hastie, Citation2004). It fosters relatedness and self-determined motivation by bringing students together to help each other learn. Since cooperative learning in PE enhances student responsibility and accountability as well as

motor skills and strategy uses (Dyson et al., Citation2004), it can also promote students' autonomy and competence. These social environments are compatible with SDT and often studied with psychological needs and motivational regulations in PE (e.g. Standage et al., Citation2003).

Extensive PE and PA literature provides evidence for the three psychological needs as mediators between social environments and motivational regulations (e.g. Markland & Tobin, Citation2010; Standage et al., Citation2003), supporting Vallerand's (Citation1997) hierarchical motivational model. Markland and Tobin's (Citation2010) study of former exercise referral clients provided initial evidence of how autonomy, competence, and relatedness mediated the relationships between social environments and the five motivational regulations. Among various social environments, autonomy support has received the most attention (Hagger et al., Citation2005), whereas few studies have investigated self-referenced and cooperative learning. To our knowledge, only two studies examined all of these three social environments in PE (Ntoumanis, Citation2001, Citation2005). Additional research is needed in order to provide evidence on the use of self-referenced criteria and cooperative learning as motivational strategies in PE and PA contexts. Findings of the present study would add evidence to the current literature on these unexamined relationships among young adults, especially in university PE courses.

Enjoyment and intention for future participation

Since one of the most important goals of university PE is to promote lifelong PA, we examined enjoyment in PE and intention for future participation in the same activity outside of PE as the motivational consequences according to Vallerand's (Citation1997) hierarchical motivational model. Enjoyment can be operationalised as a positive affective response of participation in a certain activity (Jaakkola et al., Citation2017). Theory and empirical findings have revealed that enjoyment in PE is a critical factor in determining participation in PA. Based on the trans-contextual model of motivation (TCM; Hagger, Chatzisarantis, Culverhouse, & Biddle, Citation2003), motivation in PE transfers to motivation and future intention to engage in leisure-time PA among students across cultures (Hagger et al., Citation2005). If PE is perceived enjoyable, it is more likely to lead to desirable outcomes (e.g. positive attitude towards PA), which further promote PA participation outside of PE (Jaakkola et al., Citation2017). Individuals with higher levels of self-determined motivation tend to enjoy activities more and show greater adaptive behaviour. For instance, Puente and Anshel (Citation2010) identified that perceived competence and self-determined motivation in university PE had a significant influence on students' enjoyment and exercise frequency. Edmunds et al. (Citation2008) found similar results that integrated regulation positively predicted positive affect in an exercise class, and that social environments (e.g. autonomy support) positively predicted PA intention among university students.

Many PE studies have demonstrated that enjoyment and intention for future participation are related. As Barkoukis, Hagger, Labropoulos, and Tsorbatzoudis (Citation2010) extended TCM by including psychological needs in studying high school students, they found that positive attitudes (including enjoyment) mediated the relationships between psychological needs/motivation in PE and intention for leisure-time PA over time. Therefore, enjoyment may serve as a mediator between motivation in PE and intention for future participation. This potential relationship can be explained by TCM and SDT studies in which self-determined motivation in PE promotes enjoyment (affective domain of attitude) in PE, which transfers to increased intention and behaviour in leisure-time PA (Wallhead & Buckworth, Citation2004). While TCM has mostly been used to study elementary and secondary PE, it was recently applied to a university PE

intervention and shown effective in promoting leisure-time PA (Müftüler & İnce, Citation2015). However, studies have yet to examine intention to engage in a particular sport or exercise as to how it relates to motivation and enjoyment in a university PE setting. Understanding what promotes their future intention to engage in the PE activity in an unstructured setting can inform strategies for instructors to enhance this transfer of motivation from PE to leisure-time contexts.

Purposes and hypotheses

The primary purpose of this study, therefore, was to examine the differential effects of autonomy support, self-reference, and cooperative learning on motivational regulations, and the potential mediating roles of basic psychological needs based on the initial findings of Markland and Tobin (Citation2010). Understanding the motivational sequence can help us understand how to promote current and future PA in university students, because healthy lifestyles are developed during those years and maintained throughout adulthood (Sparling & Snow, Citation2002). The secondary purpose was to investigate how the five motivational regulations in university PE related differentially to enjoyment and students' intentions for future participation in their PE activity. Specifically, we tested whether enjoyment would mediate the relationships between motivational regulations and intention.

Based on the SDT assumptions and previous research evidence (Markland & Tobin, Citation2010; Ntoumanis, Citation2001), we hypothesised that:

1. The three social environments would be positively associated with basic psychological needs and self-determined motivational regulations (i.e. intrinsic motivation and identified regulation), but negatively associated with external regulation and amotivation.
2. Autonomy support would have positive indirect effects on self-determined motivational regulations and negative indirect effects on external regulation and amotivation through each basic psychological need (see Figure 1); self-reference and cooperative learning would have similar indirect effects, but specific pathways were yet to be explored due to limited evidence available in the literature.
3. Self-determined motivational regulations would positively predict enjoyment and intention for future participation, whereas external regulation and amotivation would negatively predict these two outcomes. Enjoyment would also serve as a mediator between motivational regulations and intention (see Figure 2).

The effects of social environments and basic psychological needs on introjected regulation were not hypothesised due to the mixed findings in previous research (see Teixeira et al., Citation2012).

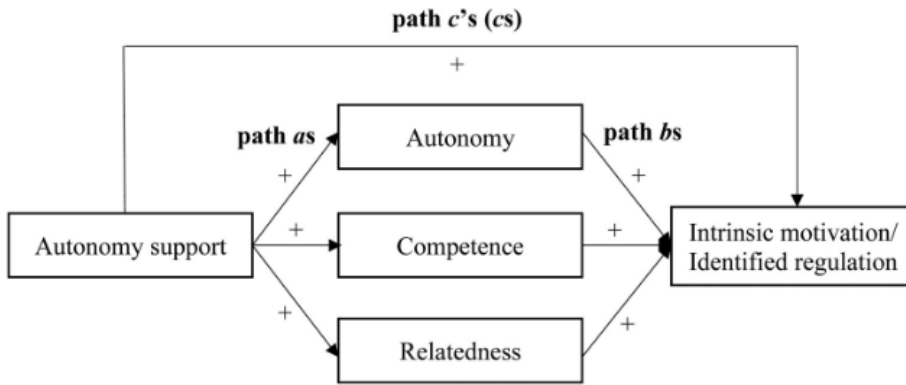


Figure 1. The hypothesised direct and indirect effects of autonomy support on motivational regulations through three psychological needs.

Note: Self-reference and cooperative learning would be tested in the same way while no specific direct and indirect effects were hypothesised.

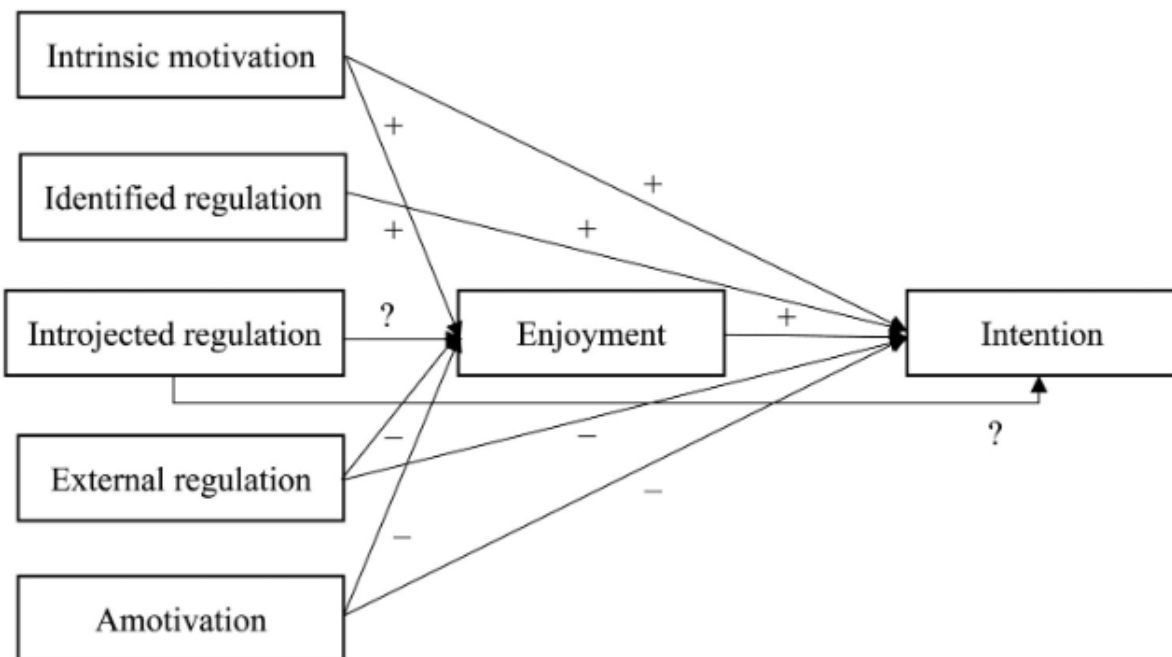
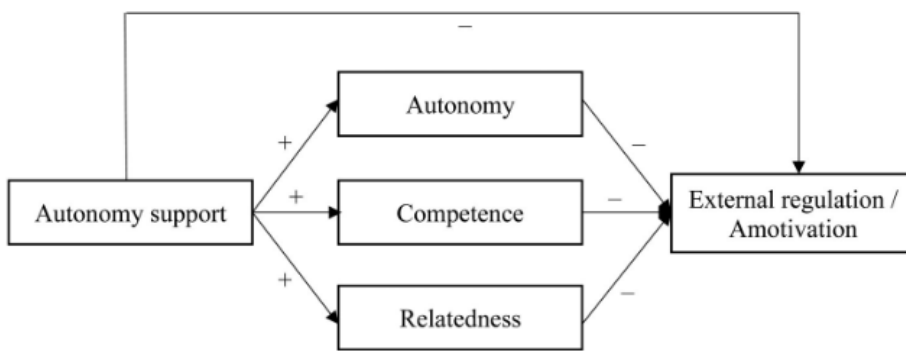


Figure 2. The hypothesised direct and indirect effects of motivational regulations on intention through enjoyment.

Method

Participants

A total of 243 university students who were enrolled in at least one PE course responded to the survey. The data of 24 students were deleted due to incomplete surveys or having substantial multivariate outliers. The final sample was 219 participants (85 males, 131 females, three unspecified; $M_{age} = 21.76$, $SD = 1.69$) from one university in Hong Kong. They were studying a two-year associate, a three-year bachelor's, or a graduate degree in arts, science, social sciences, business, or humanities. Of the 219 participants, 21.0% were first years, 19.2% were second years, 47.5% were third years, 5.5% were graduate students, and 6.8% were classified as "others". Participants were moderately physically active and reported on average engaging in approximately 150 minutes of exercise per week, including 110 minutes of PE activities. Their mean PE enrolment was 2.08 courses. PE enrolment was voluntary, and the content ranged from individual activities (e.g. yoga, golf) to team activities (e.g. hockey, handball). All 17 PE courses were taught by full-time university instructors.

Procedures

Prior to the data collection, ethical approval was obtained from the university's human and animal research ethics committee. The PE Section was then contacted to explain the study purposes and request permission to conduct research in PE courses. All course instructors agreed to have their students participate. Data were collected during the last two weeks of the semester to ensure that the social environments of PE courses had already developed. After the study was explained at the beginning of a class period, the participants signed an informed consent form and responded to a multi-section survey anonymously, taking approximately 10–15 minutes. It was emphasised to the participants there were no right or wrong responses, and that they should answer the survey according to their honest opinions and feelings towards their PE course. Participants were also offered the right to withdraw from the study at any time. For those who were enrolled in more than one PE course, they were instructed to complete only one survey regarding one of the courses.

Measures

The survey included items based on previously validated SDT scales measuring social factors, basic psychological needs, motivational regulations, enjoyment, and intention for future participation in a fixed sequence. Responses of all scales ranged from 1 (strongly disagree) to 7 (strongly agree) with moderate-to-high internal reliability in the current sample (see Table 1). The stem "In this PE course ..." was used in the measures corresponding to the social environments and psychological needs. Scores of each measure are calculated by averaging the individual item scores. Additional items on exercise behaviours (i.e. exercise frequency) and demographic information were included.

Autonomy support

The degree of autonomy support from the PE instructor was assessed with the 6-item Learning Climate Questionnaire (Williams & Deci, Citation1996), which was modified to fit the PE settings

Table 1. Descriptive statistics and bivariate correlations among study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Autonomy support	-												
2. Self-reference	.79**	-											
3. Cooperative learning	.59**	.62**	-										
4. Autonomy	.73**	.65**	.62**	-									
5. Competence	.42**	.35**	.34**	.39**	-								
6. Relatedness	.76**	.68**	.68**	.70**	.44**	-							
7. Intrinsic motivation	.66**	.59**	.50**	.58**	.55**	.66**	-						
8. Identified regulation	.59**	.54**	.40**	.56**	.49**	.59**	.74**	-					
9. Introjected regulation	.07	.11	.23**	.12	.20**	.21**	.18**	.35**	-				
10. External regulation	-.09	-.04	.14*	.00	.09	.02	-.04	.07	.77**	-			
11. Amotivation	-.32**	-.23**	-.04	-.22**	-.10	-.18**	-.28**	-.21**	.50**	.70**	-		
12. Enjoyment	.45**	.39**	.24**	.28**	.29**	.38**	.50**	.46**	.02	-.24**	-.42**	-	
13. Intention	.19**	.10	.09	.13	.29**	.21**	.26**	.28**	.35**	.23**	.11	.08	-
<i>M</i>	5.43	5.34	5.11	5.30	4.64	5.31	5.73	5.35	3.75	3.38	2.66	5.15	3.89
SD	.96	.90	1.20	.97	1.11	.97	.92	.94	1.28	1.28	1.40	.85	1.40
Cronbach's alpha	.92	.85	.92	.89	.88	.93	.92	.84	.87	.86	.93	.92	.89

* $p < .05$.** $p < .01$.

(Standage, Duda, & Ntoumanis, Citation2005). The measure assesses the degree of choice and control students have in PE participation. A sample item is “My PE teacher encourages us to ask questions”. Acceptable validities and reliabilities ($\alpha > .80$) have been shown in the university population (Williams & Deci, Citation1996) as well as different PE contexts (Ntoumanis, Citation2005; Standage et al., Citation2005)

Self-reference

Students’ perception of self-referenced criteria was assessed with the 4-item Improvement subscale of the Perceived Motivation Climate in Sport Questionnaire-2 (PMCSQ-2; Newton, Duda, & Yin, Citation2000). The PMCSQ-2 subscales were validated through the exploratory principal component analysis, followed by the confirmatory factor analysis in two corresponding studies to demonstrate concurrent validity and reliability (Newton et al., Citation2000). The measure was modified to examine PE instructors’ emphasis on improvement in student performance with an internal reliability of .73 (Ntoumanis, Citation2005). A sample item is “The PE teacher makes sure students improve on skills they’re not good at”.

Cooperative learning

Students’ perception of cooperative learning was assessed with the 4-item Cooperative Learning subscale of the PMCSQ-2 (Newton et al., Citation2000). The original measure assesses the degree of interaction in sports teams created by coaches, which was modified to assess interactions in PE with acceptable reliabilities ($\alpha > .70$) (Ntoumanis, Citation2001, Citation2005). A sample item is “Students help each other learn”.

Autonomy

Autonomy was assessed with a 5-item scale developed by Standage et al. (Citation2003). Items have been used in previous SDT studies in secondary PE with support in internal reliability ($\alpha > .80$) across samples (Standage et al., Citation2003, Citation2005). A sample item is “I have a say regarding what skills I want to practice”.

Competence

Students’ perception of competence was assessed with the Perceived Competence subscale of the Intrinsic Motivation Inventory (McAuley, Duncan, & Tammen, Citation1989). This scale was modified and used in PE settings by Standage et al. (Citation2003, Citation2005), which showed high internal reliabilities ($\alpha > .80$). A sample item is “I think I am pretty good at PE”. There is one reverse-scored item: “I cannot do PE very well”.

Relatedness

Relatedness was assessed with the 5-item Acceptance subscale of the Need for Relatedness Scale (Richer & Vallerand, Citation1998), which was originally developed to measure relatedness in the workplace and then modified to PE settings (Standage et al., Citation2003). High internal reliabilities were demonstrated ($\alpha > .80$) across samples (Standage et al., Citation2003,

Citation2005). Each item starts with the stem “With the other students in my PE course I feel”, followed by an adjective (e.g. “supported”, “understood”).

Motivational regulations

All items followed the stem “I take part in PE ...” Intrinsic motivation and extrinsic motivation were assessed with the Perceived Locus of Causality scale (Goudas, Biddle, & Fox, Citation1994). It consists of 16 items that measure intrinsic motivation and identified, introjected, and external regulations in PE. Sample items are “because PE is fun” (intrinsic), “because I want to improve in sport” (identified), “because I would feel bad about myself if I didn’t” (introjected), and “so that the teachers will not yell at me” (external). Amotivation was assessed with the Amotivation subscale of the Academic Motivation Scale (Vallerand et al., Citation1992). A sample item is “but I can’t see what I am getting out of PE”. These motivation measures were modified and validated in PE settings through confirmatory factor analysis (Ntoumanis, Citation2005; Standage et al., Citation2005), with internal reliabilities greater than .70 in each subscale except for introjected regulation ($\alpha > .60$).

Enjoyment

Enjoyment in a specific PE activity was assessed with the 18-item Physical Activity Enjoyment Scale (Kendzierski & DeCarlo, Citation1991). A sample item is “It’s very pleasant”. Eleven negatively worded items (e.g. “I feel bored”) were converted to reverse scores for data analysis. High internal reliabilities of $\alpha = .96$ were found in the two physical activities among university students (Kendzierski & DeCarlo, Citation1991).

Intention for future participation

Intention to take part in the PE activity in leisure time over the period of next month was assessed with three items based on the original work of Ajzen and Madden (Citation1986). In this study, the intention was adapted to a specific activity/sport (e.g. table tennis) of corresponding PE courses. The three items begin with “I am determined”, “I intend”, and “I plan”, respectively, followed by “to take part in the PE activity/sport at least 3 times a week during the next month”. High internal reliability of $\alpha = .89$ was reported in a PE study measuring students’ intention to exercise or play sport using the same frequency and time period (Standage et al., Citation2003).

Data analyses

There were minimal missing data (<5%) so no data were imputed. The data were analysed in three parts. First, descriptive statistics (including means, standard deviation, skewness, and kurtosis) and outlier analyses were conducted to examine the characteristics of the data set. Internal reliabilities and validities of the measures were assessed with Cronbach’s alphas and confirmatory factor analyses (CFA), respectively. CFAs were conducted using Amos 20.0 with the following indices to indicate model fit: normed chi-square index (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and root-mean-square error of approximation (RMSEA).Footnote3 Second, bivariate correlations between the study variables were computed to study the directions and magnitudes of their relationships. Third, to test the mediating roles of basic psychological needs

between social environments and motivational regulations, multiple regression models were analysed with intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation as the dependent variable. Ideally, the motivational model sequence of “social factors, psychological mediators, types of motivation, consequences” could be tested through structural equation modelling (SEM), but the current sample size was relatively small for this statistical technique. Footnote 4 In SEM, a recommended ratio of total observations (N) to total parameters (q) ranges from 5:1 (Bentler & Chou, Citation1987) to 20:1 (Jackson, Citation2003). Since there were 15 variables in our study, a much larger sample size than ours would be needed.

Prior to the regression analyses, assumptions of linear relationships and homoscedasticity among variables were tested. The assumption of linearity was confirmed visually through scatterplots, and the multivariate normality was tested using normal Q–Q plots as well as Shapiro–Wilks tests of residuals. Normal distribution was shown in most residuals (Shapiro–Wilks, $p > .05$; skewness and kurtosis $< |1.0|$), except for those of identified regulation (Shapiro–Wilks, $p < .05$; kurtosis = 1.430), of amotivation (Shapiro–Wilks, $p < .001$), of autonomy (Shapiro–Wilks, $p < .001$, kurtosis = 1.713), and of relatedness (Shapiro–Wilks, $p < .001$; kurtosis = 1.843). Collinearity did not exist with the diagnostics of tolerances (.24–.78), variance inflation factors (1.28–4.11), condition indices, and variance proportions. Due to existing non-normal data, Preacher and Hayes’s (Citation2008) bootstrapping procedures were used for testing multiple mediators of autonomy, competence, and relatedness. The PROCESS SPSS macro (Hayes, Citation2013) was employed to examine the total effects as well as direct and indirect effects among the SDT variables with respect to the hypothesised relationships. This non-parametric test is preferred to Baron and Kenny’s (Citation1986) causal-step approach by producing greater power and accuracy in analysing non-normal data as well as testing multiple indirect effects simultaneously (MacKinnon, Lockwood, Hoffman, West, & Sheets, Citation2002). The macro also calculates bootstrapped point estimates for specific indirect effects and contrasts between the effects. We used 5000 bootstrap resamples and 95% bias-corrected confidence intervals (CI) in the analysis. Indirect effects are considered significant when the CI does not include zero.

Results

Descriptive statistics and bivariate correlations

Descriptive statistics and correlation coefficients among the study variables are presented in Table 1. The internal reliabilities ($\alpha > .80$) and construct validities ($\chi^2/df < 3$, CFI $> .90$, TLI $> .90$, RMSEA $< .10$; Kline, Citation2011) are acceptable for all study measures (see Tables 1 and 2). Students generally perceived a positive social environment in PE with high degrees of autonomy support, self-reference, and cooperative learning. They had high perceived autonomy and relatedness but a moderate level of competence on average. The mean scores of motivational regulations among the participants were higher towards greater internalisation of the self-determination continuum and lower towards the less internalised end of the continuum. Thus, the sample was mostly intrinsically motivated. All social environments and basic psychological needs were positively and moderately/highly correlated with each other ($r_s = .34$ – $.79$, $p < .01$). Therefore, the more positive the social environments in PE courses were, the more likely students’ basic psychological needs were satisfied.

Table 2. Confirmatory factor analysis results.

Measure	χ^2/df	CFI	TLI	RMSEA (90% CI)
Autonomy support	.39	.99	.98	.08 (.03, .13)
Self-reference	5.75	1.00	1.00	.00 (.00, .14)
Cooperative learning	.18	1.00	1.00	.00 (.00, .14)
Autonomy	1.92	1.00	.99	.07 (.00, .13)
Competence	1.84	.99	.99	.06 (.00, .12)
Relatedness	1.57	1.00	.99	.05 (.00, .12)
Motivational regulations	2.33	.95	.93	.08 (.07, .09)
Enjoyment	2.35	.93	.91	.08 (.07, .09)
Intention	8.72	.99	.95	.19 (.09, .31)

Note: χ^2/df : normed chi-square index; CFI: Comparative Fit Index; TLI: Tucker–Lewis Index; RMSEA: root-mean-square error of approximation.

When examining the relationships between basic psychological needs and the five motivational regulations, all three needs were positively and strongly correlated with intrinsic motivation and identified regulation ($r_s = .49-.66$, $p < .01$). Competence and relatedness were also positively and weakly related to introjected regulation ($r = .20$ and $.21$, $p < .01$, respectively). In contrast, autonomy and relatedness were negatively and weakly related to amotivation ($r = -.22$ and $-.18$, $p < .01$, respectively). Accordingly, students who had basic psychological needs satisfied in the PE course tended to be more self-determined. In contrast, students who did not have their autonomy and relatedness needs met were more likely to be amotivated. The correlations among these predictors, potential mediators, and outcome variables were consistent with SDT assumptions, and thus provided the conditions for mediation analyses between social environment and motivational regulations.

In addition, enjoyment was positively and weakly/moderately associated with all social environments, all basic psychological needs, intrinsic motivation, and identified regulation ($r_s = .24-.50$, $p < .01$), but negatively and weakly/moderately associated with external regulation and amotivation ($r = -.24$ and $-.42$, $p < .01$, respectively). Intention for future participation was positively and weakly/moderately associated with autonomy support, competence, relatedness, intrinsic motivation, identified regulation, introjected regulation, and external regulation ($r_s = .19-.35$, $p < .01$). Enjoyment and intention for future participation were not significantly associated. With respect to the differential effects of motivational regulations, identified regulation was a positive predictor ($\beta = .27$, $p < .001$) and amotivation was a negative predictor ($\beta = -.17$, $p < .001$) of enjoyment, while introjected regulation was the only significant predictor ($\beta = .27$, $p < .05$) of intention. The effect sizes of the regression models for enjoyment and intention were large (Cohen's $f = .54$) and medium (Cohen's $f = .18$), respectively.

Mediation analyses

The mediation analyses between social environment and motivational regulations in PE are shown in Table 3 and Figure 3: path a is the effect of independent variables on mediators, path b is the effect of mediators on dependent variables, and path c' is the direct effect of independent variables on dependent variables. The standardised bootstrap estimates of the specific indirect effects with 95% CI are presented and replicated by the normal theory tests for statistical significance. In the models, a social environment was entered as the independent variable, three basic psychological

needs were entered as the mediators, and one motivational regulation was entered as the dependent variable. External regulation was excluded in the bootstrapped analyses due to its non-significant relationships with three basic psychological needs (MacKinnon et al., Citation2002). Similarly, introjected regulation and amotivation were excluded from mediation analyses through autonomy and competence, respectively.

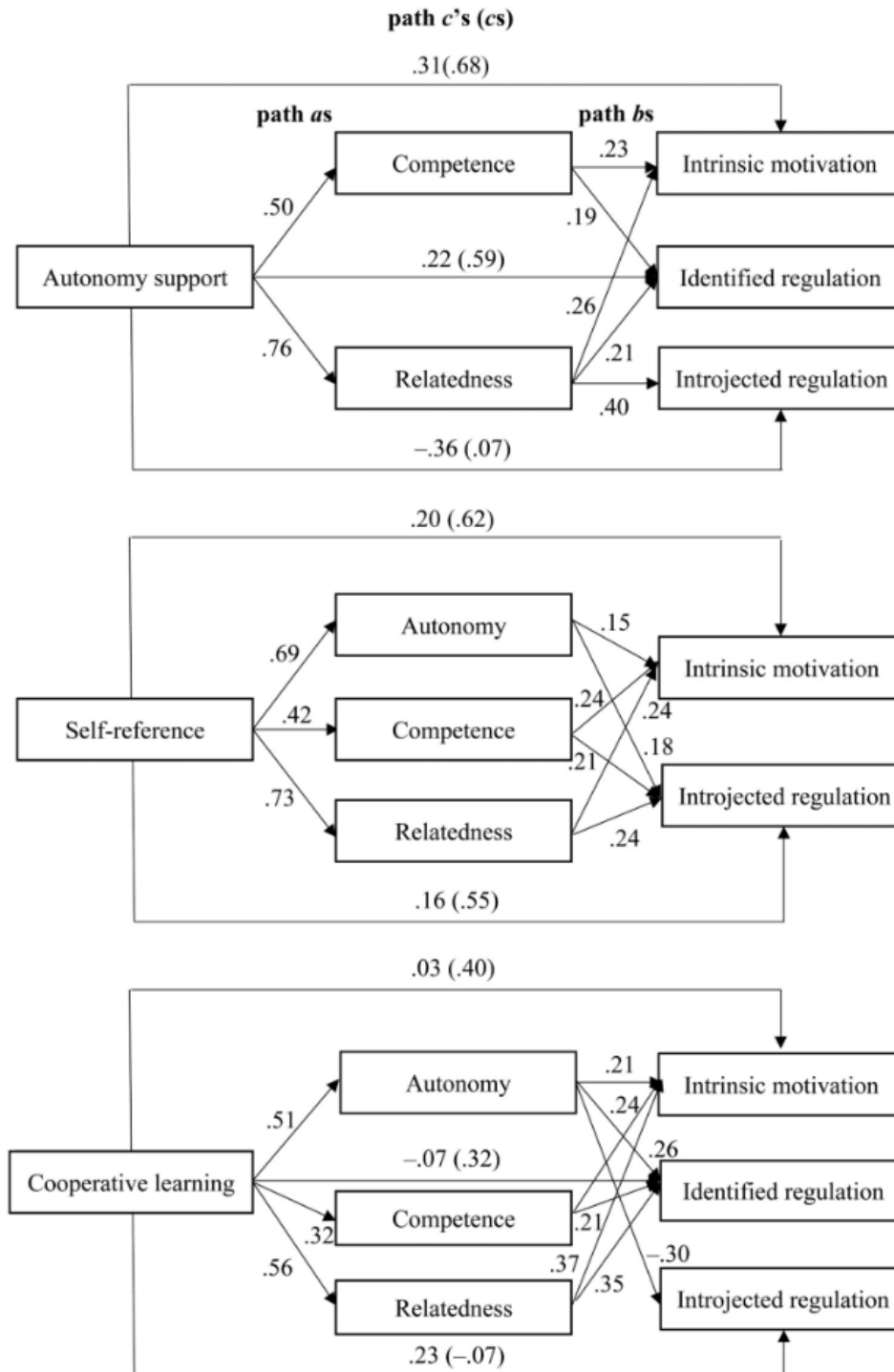


Figure 3. Regression models with direct and indirect effects of autonomy support (panel A), self-reference (panel B), and cooperative learning (panel C) on motivational regulations.

Note: Motivational regulations were tested separately in the bootstrapped mediation analyses. Only significant ($p < .05$), unstandardised path coefficients were shown. The total effects are inside parentheses and the direct effects are outside parentheses on the direct paths.

Table 3. Indirect effects of social environment on motivational regulations through psychological needs.

Dependent variable	R ²	Total effect	Indirect effect	SE of mean	95% CIs
Autonomy support → Autonomy → Motivational regulation					
Intrinsic	.57***	.38	.07	.05	(-.03, .17)
Identified	.46***	.33	.11	.06	(-.01, .24)
Amotivation	.12***	-.62	.03	.11	(-.20, .23)
Autonomy support → Competence → Motivational regulation					
Intrinsic	.57***	.42	.11	.06	(.06, .18)***
Identified	.46***	.32	.10	.03	(.04, .16)***
Introjected	.08**	-.28	.08	.05	(-.01, .19)
Autonomy support → Relatedness → Motivational regulation					
Intrinsic	.57***	.50	.19	.09	(.10, .33)***
Identified	.46***	.38	.16	.07	(.03, .29)**
Introjected	.08**	-.06	.30	.11	(.09, .51)**
Amotivation	.12***	-.12	.13	.12	(-.09, .36)
Self-reference → Autonomy → Motivational regulation					
Intrinsic	.56***	.30	.10	.05	(.01, .20)*
Identified	.46***	.29	.13	.06	(.02, .25)*
Amotivation	.06**	-.34	-.10	.10	(-.31, .09)
Self-reference → Competence → Motivational regulation					
Intrinsic	.56***	.30	.10	.03	(.05, .16)***
Identified	.46***	.25	.09	.03	(.04, .15)***
Introjected	.05*	-.02	.06	.05	(-.02, .16)
Self-reference → Relatedness → Motivational regulation					
Intrinsic	.56***	.42	.22	.05	(.12, .32)***
Identified	.46***	.34	.18	.06	(.06, .31)**
Introjected	.05*	.12	.20	.10	(-.01, .39)
Amotivation	.06**	-.25	-.01	.11	(-.23, .21)
Cooperative learning → Autonomy → Motivational regulation					
Intrinsic	.54***	.13	.10	.04	(.03, .17)**
Identified	.45***	.06	.13	.04	(.05, .22)***
Amotivation	.07**	.08	-.15	.07	(-.31, -.02)*
Cooperative learning → Competence → Motivational regulation					
Intrinsic	.54***	.11	.08	.02	(.04, .12)***
Identified	.45***	.00	.07	.02	(.03, .11)***
Introjected	.07**	.25	.04	.03	(-.02, .12)
Cooperative learning → Relatedness → Motivational regulation					
Intrinsic	.54***	.23	.20	.04	(.12, .30)***
Identified	.45***	.13	.20	.05	(.10, .30)***
Introjected	.07**	.28	.07	.08	(-.09, .22)
Amotivation	.07**	.09	-.14	.09	(-.32, .04)

Note: The bias-corrected 95% CIs refers to significance of each indirect effect.

*p < .05. **p < .01. ***p < .001.

The bootstrap results show that autonomy support had significant total indirect effects on intrinsic motivation (.37), identified regulation (.37), and introjected regulation (.43); self-reference had significant total indirect effects on intrinsic motivation (.42), identified regulation (.37), and introjected regulation (.43); and cooperative learning had significant total indirect effects on intrinsic motivation (.37), identified regulation (.40), and amotivation (−.30). Specifically, autonomy, competence, and relatedness together mediated the effects of each social environment on intrinsic motivation and identified regulation with 45–57% of the variance explained, indicating large effect sizes (Cohen's $f = .82–1.33$). Only autonomy was not a significant mediator in the relationships between autonomy support and the two regulations. Most of these indirect effects were partial mediations because the direct effects (path c' coefficients) were still significant ($p < .05$), though reduced. Only the direct effects of cooperative learning on intrinsic motivation and identified regulation were not significant, contributing to full mediation models. The tests of contrasts between significant indirect effects in each model showed significant differences only in the relationships between cooperative learning and intrinsic motivation. Cooperative learning had a significantly stronger indirect effect on intrinsic motivation through relatedness (.20) than through competence (.08). All significant mediation models also had significant total effects (see Figure 3). Comparing all of the models, autonomy support had the largest total effects on intrinsic motivation and identified regulation (.68 and .59, respectively), followed by self-reference (.62 and .55, respectively) and cooperative learning (.40 and .32, respectively).

Furthermore, relatedness mediated the association between autonomy support and introjected regulation, and autonomy mediated the association between cooperative learning and amotivation with small effect sizes (Cohen's $f = .09$ and $.08$, respectively). These mediation models had non-significant total effects due to the existence of suppressors in which the total indirect effects and the direct effects were of opposite signs and offset each other. Specifically, autonomy support had negative direct effect but positive indirect effect on introjected regulation through relatedness, and cooperative learning had positive direct effect but negative indirect effect on amotivation through autonomy. The mediating role of enjoyment between motivational regulations and intention was not tested because enjoyment and intention were not significantly correlated ($r = .08$, $p > .05$). The relationship did not meet the condition for further mediation analyses and thus enjoyment was not a mediator (MacKinnon et al., Citation2002).

Discussion

Given that university PE experience is linked to PA intention (Edmunds et al., Citation2008) and participation (Puente & Anshel, Citation2010), university administrators and PE instructors must understand university students' motivational processes in PE in order to design classes and curriculums that help students develop lifelong PA habits. The main purpose of the present study was to test differential indirect effects of autonomy support, self-referenced criteria, and cooperative learning on various forms of motivational regulations through autonomy, competence, and relatedness in PE courses. This study expanded the literature on the effects of social environments, particularly the use of self-referenced criteria and cooperative learning. In general, social environments had positive indirect effects on intrinsic motivation and identified regulation through three basic psychological needs. Higher autonomy support, self-reference, and cooperative learning predicted greater satisfaction of basic psychological needs, which in turn predicted higher self-determination.

Differential effects of social environments

The results partially supported the first hypothesis and the literature on the associations of autonomy support, self-reference, and cooperative learning with motivational regulations. The moderate-to-high correlations between social environments and self-determined motivation in our study were similar to the previous findings in secondary optional PE ($r_s = .40-.53$; Ntoumanis, Citation2005) and higher than those in secondary mandatory PE ($r_s = .28-.45$; Ntoumanis, Citation2001). This implies that social environments in an optional PE setting are more strongly associated with self-determined motivation than in a mandatory PE setting. University students who perceived PE social environments with higher autonomy support, self-reference, and cooperative learning also reported higher self-determination and enjoyment in PE. These results are consistent with motivational theoretical frameworks (Deci & Ryan, Citation2000; Hagger et al., Citation2003) on the importance of optimal learning environments. When instructors include a wide range of learning activities and teaching strategies that focus on choices, self-referenced feedback, and cooperation in PE, it will very likely result in adaptive motivational outcomes.

Unexpectedly, cooperative learning was positively related to introjected and external regulations in addition to intrinsic motivation and identified regulation. The magnitude of the correlations in the former regulations was smaller than the latter ones, which suggests that cooperative learning was more likely to produce self-determined motivation than non-self-determined motivation. In a constraining PE course structure, some students might want to demonstrate their competence to gain self-worth and acceptance from instructors and classmates, potentially leading to higher introjected and external regulations (Jaakkola et al., Citation2017). Non-self-determined motivation, attributed to these social needs and the competitive nature in PE, might be promoted in an environment that included greater cooperative learning.

Mediating effects of basic psychological needs

The second hypothesis was partially supported by the mediating effects of autonomy, competence, and relatedness being consistent with most SDT assumptions (Deci & Ryan, Citation2000). These basic psychological needs are significant indirect agents that transferred the positive social environments to greater self-determined motivation, supported by the large effect sizes for each mediation model of intrinsic motivation (Cohen's $f = 1.17-1.33$) and identified regulation (Cohen's $f = .82-.85$). Interestingly, only autonomy was not a mediator in the indirect effects of autonomy support on intrinsic motivation and identified regulation, but they were very close to be statistically significant with 95% CIs of $(-.03, .17)$ and $(-.01, .24)$ in the bootstrapped estimates, respectively. While satisfying autonomy needs could be important to students who possess certain sport skills, having choices in practice might not be as crucial for those who do not have related experience (Ntoumanis, Citation2005). Most students in Hong Kong take PE courses in order to engage in organised PA rather than competing in a particular sport. Thus, they would prefer being guided to making many decisions in PE. Moreover, there were potential spurious relationships in which autonomy support predicted autonomy and self-determined motivation while autonomy did not predict the regulations directly in the regression models. A spurious relationship is equal to the correlation coefficient minus the total effect of the variable so the spurious effects of autonomy support on intrinsic motivation and identified regulation were $.28$ and $.26$, respectively. Approximately 42% and 44% of the corresponding relationships were due to common causes.

Regarding the indirect effects of cooperative learning on intrinsic motivation and identified regulation, bootstrapped analyses indicated full mediation models, suggesting that their relationships are a product of three basic psychological needs. Therefore, basic psychological needs played the most important roles in cooperative learning compared to the other two social environments for enhancing self-determination. Cooperative learning encourages students to strive for mutual gains such that all members in the group learn more effectively from mutual efforts (Dyson et al., Citation2004). Eight studies conducted by Johnson and Johnson (Citation2005) have shown that cooperativeness is positively associated with autonomy, self-confidence, and social relations, which are similar to basic psychological needs. Since helping group members is emphasised in collectivistic cultures, students often attribute their success to classmates and teachers to fulfil each other's psychological needs. This might explain why cooperative learning had indirect effects through all psychological needs with relatedness as the strongest mediator, while previous research in an individualistic culture demonstrated its indirect effects only through relatedness (Ntoumanis, Citation2001).

On the other hand, interesting suppression effects of relatedness and autonomy were found on introjected regulation and amotivation, respectively. In accord with Markland and Tobin's (Citation2010) study on differential mediation effects of basic psychological needs, relatedness positively mediated the relationship between autonomy support and introjected regulation, whilst autonomy and competence did not. Although the direct effect of autonomy support is negative, satisfying relatedness needs in an autonomy-supportive environment could result in introjection. This finding implies that satisfying both autonomy and competence needs is essential to developing self-determined motivation. Conversely, cooperative learning had a positive direct effect on amotivation, but autonomy negatively mediated the relationship between them. This highlights that the fulfilment of autonomy needs is necessary for preventing amotivation if cooperative learning strategies are used. In practice, PE instructors may give students some freedom in choosing group members and deciding some PE activities they would like for cooperation. Dyson et al. (Citation2004) also suggest some pedagogical considerations for cooperative learning by assigning students to heterogeneous small groups, modifying games for interests and active learning, and holding students accountable. If cooperative learning was not used properly, it could lead to amotivation due to group conflicts or negative competitions between or within groups. Overall, the effect sizes of the introjected regulation and amotivation mediation models were small. This is supported by recent SDT research that suggests that controlling social environments and frustrating psychological needs, instead of positive social environments and satisfying psychological needs, are better predictors of non-self-determined motivation and negative outcomes (Vansteenkiste & Ryan, Citation2013).

Relatedness played the most significant mediating role between social environments and self-determined motivation by producing the greatest indirect effects. This seems contradictory to the notion that autonomy is the central to and competence is important for self-determined motivation, and that relatedness only facilitates introjected and identified regulation (Koestner & Losier, Citation2002). Indeed, high school sport-based PE studies have shown that relatedness was the only psychological need along with self-determined motivation that significantly increased over a four- to six-week period (Perlman, Citation2011; Tessier, Sarrazin, & Ntoumanis, Citation2010). Students may perceive relatedness as important for developing self-determination in university PE (mostly sport-based) due to its dynamic and cooperative nature.

Differential effects of motivation regulations on enjoyment and intention

The third hypothesis was partially supported. The regression results of enjoyment and intention for future participation in the PE activity are worthy of consideration, though not the primary purpose or intent of the present study. Consistent with our hypotheses and SDT studies, identified regulation positively predicted and amotivation negatively predicted enjoyment in PE (Jaakkola et al., Citation2017). Intrinsic motivation and external regulation were not significant predictors of enjoyment, although they were significantly related to enjoyment in bivariate correlation. Contrary to our expectation and previous studies (Ntoumanis, Citation2001; Standage et al., Citation2003), neither self-determined motivation nor amotivation predicted intention, and introjected regulation positively predicted intention. Since introjection originates from the perceived need to give values to perform certain behaviours, it might not be maladaptive in education (Vallerand, Citation1997). Thus, students with introjected regulation in PE might start realising the benefits and values of the activity after a semester and decide to continue. In addition, the data collection period was less than a month before the final examination week, which made it hard for self-determined students to have high intention to do a PE activity in leisure time. Students might be more effectively motivated by guilt and shame instead of pure interest in the short term.

Our hypothesis regarding the mediating effects of enjoyment between motivational regulations and intention was not supported. It is somewhat surprising that enjoyment was not associated with intention in the present study. This could be attributed to the method effect that intention was assessed on a specific PE activity rather than leisure-time PA as measured in previous studies (e.g. Standage et al., Citation2003). Students may not want to participate in a sport or activity in their leisure time in addition to their PE course unless they are specialised in that sport (i.e. an athlete). Although it appears that enjoyment is not a mediator between motivation and intention in this study, future research should continue to test this relationship based on recent findings supporting its mediating role on PA participation (Jaakkola et al., Citation2017).

Implications and limitations

The study results have significant implications for university PE instructors. First and foremost, instructors are encouraged to employ autonomy support, self-reference, and cooperative learning to promote students' basic psychological needs and self-determination. These psychosocial outcomes of PE can further enhance students' enjoyment and potentially their future participation in the PE activity and PA in general. Furthermore, this study supports Markland and Tobin's (Citation2010) notion of differential indirect effects and provides evidence on the mediating roles of autonomy, competence, and relatedness on different motivational regulations. These findings are similar to the studies done in Western PE settings on the impact of social environments as well as the motivation processes irrespective of cultural differences (Ntoumanis, Citation2001, Citation2005). Thus, the present study provides additional evidence on the application of SDT in PE intervention among Eastern cultures. Specifically, it suggests that instructors promote (a) autonomy support by providing students options in choosing activities that match their skills and preference, (b) self-reference by emphasising improvement and giving individualised positive feedback, and (c) cooperative learning by offering a variety of group activities. These strategies will likely fulfil students' basic psychological needs and in turn enhance their self-determination in PE.

The main limitation of this study is a small sample size. Because our convenient sample consisted of students in only one university and corresponding PE courses, it might not be representative of all university students in Hong Kong or generalisable to the student population in other regions and countries. Another potential limitation is the high mean scores ($M_s > 5.0$) of self-determined motivation and enjoyment for PE activity in this sample, which may not represent typical PE courses. This may be due to optional instead of mandatory PE participation such that students were already self-determined before participation. Similar mean scores were indeed shown by previous university PE studies (Edmunds et al., Citation2008; Puente & Anshel, Citation2010). Order effect may also be an issue. As participants completed the fixed sequential survey, their initial responses of perceived social environments and psychological needs could have influenced their latter responses of motivational regulations and outcomes in the same survey. Moreover, causal inferences of psychological needs and motivational regulations cannot be drawn from this study. Randomly assigning participants into intervention and control groups of different social environments is recommended for further examination of the causal relationships. Replicating the study across PE settings with hierarchical linear modelling will help clarify within- and between-class differences in the impacts of social environments and psychological needs. Longitudinal studies are also needed to help us better understand the role of introjected regulation on exercise behaviours due to its potential positive short-term and negative long-term influences (Teixeira et al., Citation2012).

Notwithstanding the limitations, this study adds to the existing literature by incorporating three social environments in examining PE motivation in a Chinese university population. TCM (Hagger et al., Citation2003) was applied in understanding how PE motivational processes may transfer to leisure-time contexts. Our results provide initial evidence on the specific effects of each social environment while suggesting some differences in the mediating roles of psychological needs on specific motivational regulations. In conclusion, the results are in accord with SDT and infer crucial practical implications for PE instructors to enhance autonomy support, self-reference, and cooperative learning with proper strategies in university PE courses, particularly in Hong Kong.

Notes

1. Although integrated regulation is categorised as extrinsic motivation, it is considered to be the most self-determined form and traditionally incorporated in the measures of identified regulation (Ryan & Deci, Citation2000).
2. During data collection, Hong Kong still adopted the educational system with three years of undergraduate studies. It has been changed to the current system of four-year programmes since 2012.
3. Note that $\chi^2/df > 3$ for the Self-reference and Intention measures, as well as $RMSEA > .10$ for the Intention measure, because of small degrees of freedom ($df = 1$). We examined the $RMSEA$ 90% CI of the Intention measure which included .10, indicating acceptable fit. For a discussion of elevated $RMSEA$ with small df and sample size, see Kenny, Kaniskan, and McCoach (Citation2015).
4. We also conducted two path analyses (full model and model with only significant paths) using SEM to compare the results with multiple mediation analyses. However, both models resulted in poor model fits: Full model $\chi^2(28) = 592.85$, $p < .001$, $CFI = .66$, $TLI = .32$, and $RMSEA = .301$, 90% CI [.28, .32]; model with only significant paths $\chi^2(39) = 613.571$, $p < .001$, $CFI = .65$, $TLI = .51$, and $RMSEA = .58$, 90% CI [.24, .28]. Small sample size was an issue as most of the paths were statistically significant ($p < .05$).

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