

Research article

## Effect of Autonomy Support on Self-Determined Motivation in Elementary Physical Education

Yu-Kai Chang<sup>1</sup>, Senlin Chen<sup>2</sup>✉, Kun-Wei Tu<sup>1</sup> and Li-Kang Chi<sup>3</sup>

<sup>1</sup> Graduate Institute of Athletics and Coaching Science, National Taiwan Sport University, Taiwan; <sup>2</sup> Department of Kinesiology, Iowa State University, USA; <sup>3</sup> Department of Physical Education, National Taiwan Normal University, Taiwan

### Abstract

Using the quasi-experimental design, this study examined the effect of autonomy support on self-determined motivation in elementary school physical education (PE) students. One hundred and twenty six participants were assigned to either the autonomy support group (n = 61) or the control group (n = 65) for a six-week intervention period. Perceived teacher autonomy, perceived autonomy in PE, and self-determined motivation in PE were pre- and post-tested using validated questionnaires. Significant increases in perceived teacher autonomy and perceived autonomy in PE were observed in the autonomy support group, but not in the control group. Intrinsic motivation was higher in the autonomy support group than that in the control group. From an experimental perspective, these findings suggest that the autonomy support was successfully manipulated in the PE classes, which in turn increased the students' perceived autonomy and intrinsic motivation.

**Key words:** Intrinsic motivation, perceived autonomy, self-determination theory.

### Introduction

Physical activity (PA) shows a decline trend in youth as they grow older (Nader et al., 2008; Troiano et al., 2008). School physical education (PE) functions as a viable channel to promote youth PA either directly (Bassett et al., 2013; Pate et al., 2011) or indirectly (e.g., by fostering students competence and motivation; Chen and Ennis, 2009). Psychological research has shown that students that are motivated often display stronger effort, intention, and persistence in behavior than students who are less motivated or unmotivated (Bryan and Solmon, 2007; Pintrich, 2003). In PE, creating a motivational learning environment is important to facilitate engagement and learning (Braithwaite et al., 2011; Todorovich and Curtner-Smith, 2002; 2003). PE teachers play a vital role in creating educational environments that support students' needs and enhance their motivation (Ntoumanis, 2005; Shen et al., 2009).

The self-determined theory (SDT) is one of the mature motivation theories applied in exercise and sport sciences, including PE pedagogy. According to the SDT, in an educational setting in particular, a learner's level of motivation is positioned on the continuum polarized by intrinsic motivation (i.e., undertaking an activity for its own sake) and amotivation (i.e., lack of any motivation) (Deci and Ryan, 1985; Ntoumanis, 2001). Along the con-

tinuum, from the more self-determined to the less self-determined, are four levels of extrinsic motivation: integrated regulation, identified regulation, introjected regulation, and external regulation (Deci and Ryan, 1985). With integrated regulation, a learner is motivated by reckoning the significance of a behavior. For example, a student recognizing the health benefits of PA believes regular exercising is a part of daily life and then take actions in behavior. For identified regulation, a learner's motivation is often derived from the sense of identity in engaging in the behavior. For example, when PA is viewed as a behavior that defines the self as a person, the student's exercise intention, effort, and persistence become proactive. For introjected regulation, motivation tends to be characterized by a sense of guilt or jeopardy (e.g., feeling guilty for not committing time to exercise as planned). Using the same example as above, a learner with introjected regulation may feel the urge not to disappoint people (including themselves) and then discipline to participate in PAs. For external regulation, a learner's motivation relies on the extent to which he/she may obtain a reward or avoid a punishment as consequence of the behavior. Examples of external regulation in PE include receiving praise/criticism from the teacher for displaying active participation in PA both in and outside of PE classes.

A person is believed to have three innate psychological needs, namely, the needs to perceive competence (feeling competent and capable), autonomy (having choice and control), and relatedness (feeling affiliated with others in the context) (Deci and Ryan, 1985). The extent to which these three needs are supported and satisfied largely dictates the level of self-determined motivation, with greater needs satisfaction being associated with higher level of motivation; vice versa (Deci and Ryan, 1985). In the context of PE pedagogy, researchers have explored the relationships between providing needs support to students and how that impacts self-determined motivation as well as subsequent motivation outcomes (i.e., need support → need → satisfaction → motivation → motivation outcomes; Deci and Ryan, 1985; Ntoumanis, 2001; Sun and Chen, 2010). Cross-sectional evidence indicates that supporting learners' needs for perceiving competence, autonomy, and relatedness in PE classes predicts autonomous motivation, which in turn predicts participation in leisure-time PA (Hagger et al., 2005; Ntoumanis, 2005; Shen et al., 2009). More self-determined students with higher levels of motivation tend to exert higher effort (Cox et al., 2011; Taylor et al.,

2010) and experience greater intention (Lim and Wang, 2009; Taylor et al., 2010), enjoyment (Cox et al., 2013; McDavid et al., 2014), PA levels (Cox et al., 2013; Taylor et al., 2010), active game participation (Wallhead et al., 2013), and enhanced cardiorespiratory fitness (Shen et al., 2009). Despite the importance to satisfy all three innate psychological needs (Shen et al., 2009; 2012), the extant literature shows that providing strong support for autonomy stands out as the most salient factor for eliciting self-determined motivation and motivational responses (Hagger et al., 2005; Lonsdale et al., 2013; Shen et al., 2009).

The most relevant application of the SDT in PE pedagogy probably lies in the fact that the teacher can motivate students to engage and learn during class by providing needs support. Intervention studies aimed at increasing students' self-determined motivation in PE are well-documented in the research literature. Of the three needs support, it is obvious that most studies have attempted to provide autonomy support in PE classes in the attempt to stimulate students' motivation. For example, Prusak et al. (2004) examined the effects of choices in PE on the motivation of seventh- and eighth-grade female students. The choices studied included allowing students to choose learning activities and partner(s) during a ten-day intervention. Forty-two intact classes were assigned to the choice group or the no-choice group. The study found that the choice group reported higher intrinsic motivation and identified regulation but lower external regulation and amotivation than the control group (Prusak et al., 2004). Similarly, Tessier et al. (2010) instructed teachers to change their teaching styles to facilitate 9th - 11th grade students' (mean age = 16.56 years old) motivation in sport-based PE classes, which led to increased need satisfaction, self-determined motivation, and in-class engagement. To further examine the effect of needs support on behavioral outcomes, Lonsdale et al. (2013) intentionally manipulated PE classes by assigning classes into one of the four conditions: (a) explaining relevance, (b) providing choice, (c) providing a completely free choice, or (d) control. The interventions significantly enhanced eighth grade students' perceived autonomy in both of the choice-based groups; the "free choice" intervention increased PA, and the choice-based interventions decreased sedentary behavior (Lonsdale et al., 2013). Likewise, Chatzisarantis and Hagger (2009) successfully trained teachers to adopt and implement the autonomy supportive instruction during PE classes. This intervention led to stronger intentions to exercise and higher leisure-time PA levels among high school students (mean age = 14.84) compared to the control group.

As shown above, most of the research studies that have adopted the SDT as theoretical lens have employed the cross-sectional, observational research design; while more intervention studies using experimental designs are few and needed. Furthermore, successful SDT-guided interventions in PE were mostly conducted by making instructional changes such as providing autonomy support to students during class. Nevertheless, these interventions focused on older adolescents enrolled in secondary school PE as the research population, and these studies were

exclusively conducted in the western societies (e.g., Australia, the Europe, U.S.A., etc.). It remains unclear whether SDT-guided interventions featuring autonomy support manipulation in younger students from non-western societies will lead to a motivational learning context that enhances students' motivation. Thus, the purpose of this study was to evaluate the effect of a carefully manipulated PE course on elementary-school students' motivation. It was hypothesized that students enrolled in SDT-guided PE classes (i.e., the autonomy support group) would perceive higher autonomy support and display higher self-determined motivation than students in the control group.

## Methods

### Participants

The sample consisted of 126 students (Male,  $n = 65$ ; Female,  $n = 61$ ) in a district of New Taipei City, Taiwan. These participants originated from four classes that were randomly selected from 12 classes (6th grade level) offered at a local elementary school. Prior to data collection, we obtained permission from the principal and head teachers of the school to conduct the study. In addition, all of the participants' parents or guardian provided consent forms approved by the Institutional Review Board of National Taiwan Sport University before participating in the study. The participants were assigned to the autonomy support group (two classes,  $n = 61$ ) or the control group (two classes,  $n = 65$ ). Table 1 presents the summary of the demographic data of the two groups.

**Table 1. Participant demographic data between control and autonomy physical education groups. Data are means ( $\pm$ SD).**

Variables	Control Group	Autonomy support Group
N	65	61
Female	30	31
Age (yr)	13.7 (.5)	13.7 (.5)
Body mass index ( $\text{kg}\cdot\text{m}^{-2}$ )	20.6 (4.1)	20.6 (4.4)
<b>PA experiences</b>		
Sport team (yes %)	10.8%	4.9%
Sport club (yes %)	10.8%	8.2%
PA status (yes %)	47.7%	54.1%
<b>Partners (%)</b>		
along	10.8%	9.8%
family member	21.5%	31.1%
classmate/friend	41.5%	26.2%
no specific	26.2%	32.8%
Parent's PA status (yes %)	30.8%	34.4%

PA experiences = physical activity experiences; Sport team = whether participating sport team; Sport club = whether participating sport club; PA status = whether participating in PA regularly through moderate-intensity exercise, three times per week, for 20 minutes each time; Partners = partners for PA. Parent's PA status = parent's PA status.

### Experimental Procedures

The experimental procedures of the present study included pre-test, intervention, and post-test stages. During the first stages, the participants were asked to complete the demographic information and PA history questionnaires a week before the intervention. The questionnaires involved questions associated with PA experiences based upon students' involvement during the previous month, includ-

ing: a) whether they have participated in a sports team (Y/N); b) whether they have participated in a sports club (Y/N); c) whether they have participated in regular PA by exercising with moderate intensity, three times a week, for 20 minutes each time (Y/N); d) whether they have partners during their PA participation (e.g., alone, family, classmate); and e) whether their parents are physically active (Y/N). These questions were used to examine and control for potential confounders for motivation in PE lessons. Participants were then instructed to complete three additional main questionnaires that assessed perceived teacher autonomy, perceived autonomy in PE, and self-determined motivation in PE. These questionnaires were read to the participants and questions were answered in a timely manner.

In the intervention stage, participants were assigned to the autonomy support group or the control group. The PE classes at the participating school were offered 40-minute long classes twice per week for six weeks. It included six activities as the primary instructional content (i.e., running, jumping, Chinese yo-yo, vaulting boxes, badminton, and basketball). Each activity was taught twice per week.

Perceived autonomy was manipulated at two levels: a) sequence of the PE content, and b) selection of the sub-content. In the autonomy supportive groups, participants were permitted to discuss the sequence of the PE content for the next six weeks, and decisions were made by consensus. In addition, each lesson was segmented into four sections, in which at least two sections were designed for sub-group practices. For example, the running lesson includes an introduction to running, straight running, curve running, and relay practice; whereas the other three sections engage in group-based practice/training with groups of four to six students. Participants in the autonomy supportive group could choose their partners. The participants in the control group received identical overall PE content and skill instructions; however, the sequence of content for the six weeks of the study was teacher-determined. In addition, students' group partners were arbitrarily assigned by the PE teacher for each lesson. The teacher did not allow requests from the participants to change partners. All four PE classes were taught by a certified PE teacher who had more than 12 years of teaching experiences.

The third stage was similar to the first stage for post-experiment assessment. Participants completed the same questionnaires as baseline in the final week of the PE classes. The same researcher administered the post-experiment data collection.

### Instrumentation

**Perceived teacher autonomy:** Students' perceived autonomy offered by their PE teacher was measured by a short questionnaire with six questions. These questions were designed using a seven-point Likert scale with choices ranging from 1 = strongly disagree to 7 = strongly agree. For example, one question is phrased as I think my PE teacher listens to our opinions in class. The short questionnaire was adapted from Standage et al. (Standage et al. 2006). The construct's Cronbach's alpha was 0.76.

**Perceived autonomy in PE:** Students' perceived autonomy in PE was measured by a short questionnaire with five questions. These questions also used a seven-point Likert scale with choices ranging from 1 = strongly disagree to 7 = strongly agree. For example, one question is phrased as I could choose what content to learn in PE. The short questionnaire was adapted from Standage et al. (Standage et al., 2006). The construct's alpha was 0.72.

**Self-determined motivation in PE:** Students' self-determined motivation in PE was measured by a questionnaire with 30 questions. Five factors are captured by these questions: intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. These questions also used a seven-point Likert scale with choices ranging from 1 = strongly disagree to 7 = strongly agree. For example, one question for intrinsic motivation is phrased as I partake in PA in PE class is because PA is fun. Exemplified questions for identified regulation, introjected regulation, external regulation, and amotivation are "I feel strange if I don't do PA in PE class", "I feel guilty if I have no PA in PE class", "I do PA in PE class in order to have good score", and "I have no idea why do PA in PE class". The Taiwanese version of short questionnaire was adapted from Ntoumanis (2001). Cronbach's alpha for the five factors ranged from 0.77 to 0.91.

### Statistical analysis

Descriptive data are shown as mean and standard deviations (SD) in text and standard error (SE) in figures. Where appropriate, a t-test or chi-square was applied to test the demographic differences between autonomy support and control groups. A two-way repeated-measures analysis of variance (ANOVA) within a group's between-subject factor (i.e., two group) and time-point (i.e., pre- and post-test), along with its within-subject factor, was employed separately to test autonomy-related alterations as a function of group and time-point (i.e., perceived teacher autonomy and perceived autonomy in PE). The ANOVA also served as a manipulation check for autonomy support.

A similar two-way ANOVA was employed to test the alterations of five types of motivation (i.e., amotivation, external motivation, introjected regulation, identified regulation, and intrinsic motivation). Results were presented using the Greenhouse-Geisser statistics. Significant main and interaction effects were further analyzed by multiple t-test comparisons using the Bonferroni correction ( $\alpha=0.05$ ). Partial eta-square was presented as effect size.

## Results

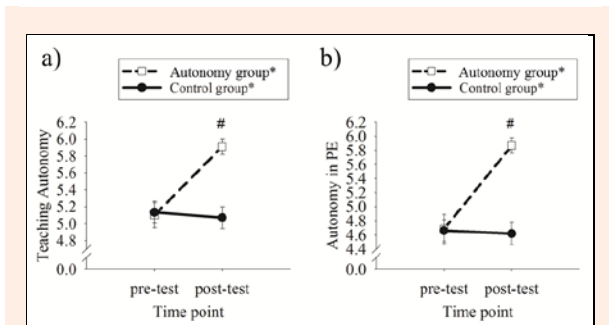
### Participant Demographic Data

The t-test revealed no difference regarding age and body mass index between autonomy support and control groups ( $t_s = -0.81$  to  $0.03$ ,  $p_s > 0.05$ ). Similarly, chi-square tests showed no difference among demographic variables related to each PA variable (i.e., sport team, sport club, PA status, partner, and parents' PA status) between the two groups (chi-square =  $0.24$  to  $3.77$ ,  $p_s > 0.05$ ).

**Perceived autonomy**

*Perceived Teaching Autonomy:* There was a significant main group effect,  $F(1,124) = 6.91, p = 0.01$ , partial  $\eta^2 = 0.53$ , along with a main time effect,  $F(1,124) = 15.63, p = 0.001$ , partial  $\eta^2 = 0.11$ . Significant group by time interaction was also revealed,  $F(1,124) = 21.50, p = 0.00$ , partial  $\eta^2 = 0.15$ . Follow-up multiple comparisons revealed that the autonomy support group demonstrated higher post-test than pre-test scores ( $p = 0.001$ ). Additionally, the autonomy support showed higher post-test scores relative to the control group ( $p = 0.001$ ). No difference was observed during pre-test conditions (Figure 1a).

*Perceived Autonomy in PE:* There was a significant main group effect,  $F(1,124) = 10.38, p = 0.002$ , partial  $\eta^2 = 0.08$ , and a main time effect,  $F(1,124) = 26.66, p = 0.001$ , partial  $\eta^2 = 0.18$ . Significant interaction of group and time was also revealed,  $F(1,124) = 30.62, p = 0.001$ , partial  $\eta^2 = 0.20$ . Multiple comparisons found that the autonomy support group, not the control group, demonstrated higher scores in post-test than in pre-test ( $p = 0.001$ ). Additionally, they also showed higher scores in in post-test compared to the control group ( $p = 0.001$ ). No difference was observed in the pre-test condition (Figure 1b).



**Figure 1.** Illustration of perceived autonomy data as function of group and time point. **a)** perceived teaching autonomy and **b)** perceived autonomy in physical education. \* significant difference within time points,  $p < 0.05$ . # s significant difference between the two groups,  $p < 0.05$ .

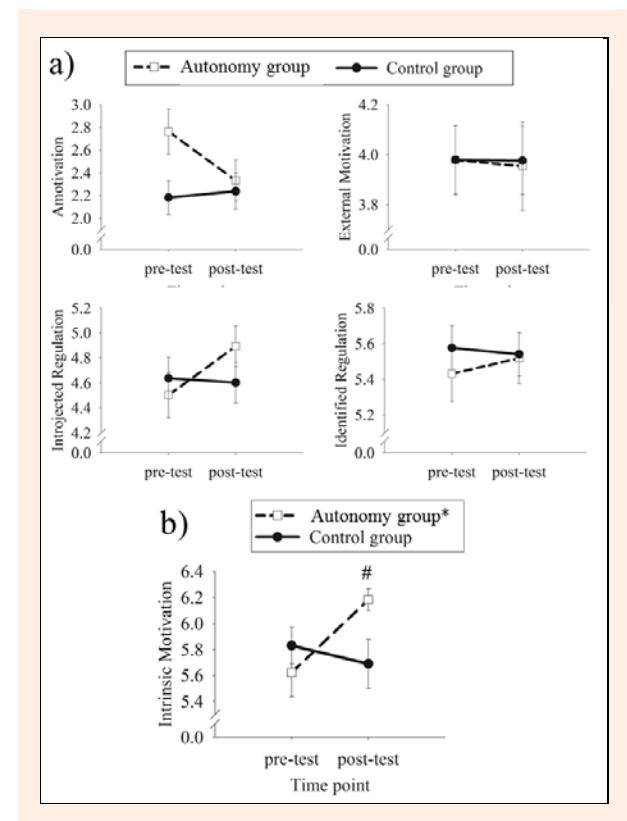
**Self-determined motivation in PE**

Statistical values for self-determined motivation in PE by group the time points are presented in Table 2.

*Amotivation:* There was no significant group effect,  $F(1,124) = 2.64, p = 0.11$ ; time effect,  $F(1,124) = 3.65, p = 0.06$ ; or interaction effect,  $F(1,124) = 2.15, p = 0.15$  (Figure 2a).

*External motivation:* There was no significant group effect,  $F(1,124) = 0.005, p = 0.94$ ; time effect,  $F(1,124) = 0.01, p = 0.91$ ; or interaction effect,  $F(1,124) =$

$0.01, p = 0.92$ .



**Figure 2.** Illustration of self-determined motivation in physical education as function of group and time point: **a)** amotivation, external motivation, introjected regulation, and identified regulation; and **b)** intrinsic motivation. \*significant difference within time points,  $p < 0.05$ . #significant difference between the two groups,  $p < 0.05$ .

*Introjected regulation:* There was no significant group effect,  $F(1,124) = 0.14, p = 0.71$ ; time effect,  $F(1,124) = 0.14, p = 0.08$ ; or interaction effect,  $F(1,124) = 3.21, p = 0.08$ .

*Identified regulation:* There was no significant group effect,  $F(1,124) = 0.27, p = 0.61$ ; time effect,  $F(1,124) = 0.06, p = 0.81$ ; or interaction effect,  $F(1,124) = 0.35, p = 0.56$ .

*Intrinsic motivation:* There was no significant group effect,  $F(1,124) = 0.60, p = 0.44$  or time effect,  $F(1,124) = 2.92, p = 0.09$ . However, a significant interaction of group and time was revealed,  $F(1,124) = 8.18, p = 0.005$ , partial  $\eta^2 = 0.06$ . Follow-up multiple comparisons found that the autonomy support group, not the control group, demonstrated higher scores in the post-test than in the pre-test ( $p = 0.002$ ). They also showed higher scores in post-test compared to the control group ( $p = 0.02$ ), whereas no difference was observed during pre-test (Figure 2b).

**Table 2.** Self-determined motivation in physical education by group the time points. Data are means ( $\pm$ SD).

Variables	Control Group		Autonomy support Group	
	Pre-test	Post-test	Pre-test	Post-test
Amotivation	2.18 (1.20)	2.24 (1.28)	2.76 (1.56)	2.33 (1.42)
External Motivation	3.98 (1.09)	3.98 (1.09)	3.98 (1.09)	3.95 (1.38)
Introjected Regulation	4.64 (1.33)	4.60 (1.30)	4.50 (1.42)	4.89 (1.28)
Identified Regulation	5.58 (1.00)	5.54 (.97)	5.43 (1.22)	5.52 (1.11)
Intrinsic Motivation	5.83 (1.14)	5.69 (1.52)	5.62 (1.44)	6.18 (.66)

## Discussion

This study evaluated the effect of autonomy support on students' perceived autonomy and self-determined motivation in elementary-school PE classes in Taiwan. The quasi-experimental design enabled the researchers to compare the outcomes between the experimental and control groups. Although mature motivation theories (e.g., achievement goal theory and the SDT) have been applied in PE to study students' motivation (Braithwaite et al., 2011; Shen et al., 2009; Todorovich and Curtner-Smith, 2002; 2003), most of these studies were cross-sectional or observational in nature. Few SDT-based intervention studies in PE pedagogy that are based on experimental designs have been conducted, and these studies mainly focused on older adolescents in upper middle school or high schools in non-western societies. This present study was one of the earliest studies that attempted to create motivational PE environments from the SDT perspective in elementary schools in Taiwan. The intervention demonstrated favorable findings in the experimental group compared to the control group. These findings are discussed below.

The evaluation of this intervention shows that manipulation of the PE environment was successful. The methods we used to manipulate the PE classes involved utilizing strategies such as giving students more choices in selecting partners and learning content instead of the teacher completely controlling everything in the class. Such manipulations of choice have been used in other research studies as documented in the research literature (e.g., Chatzisarantis and Hagger, 2009; Lonsdale et al., 2013; Tessier et al., 2010). As in other intervention studies, the changes made to the instructional conditions in this study were recognized and appreciated by the Taiwanese students. Compared to those in the control group, the students who received a choice-based intervention (with autonomy support) experienced significantly higher levels of perceived autonomy from the teacher's instructional behaviors as well as from the PE lessons overall. This set of findings suggests that like PE classes in the western societies, the SDT is also indeed a powerful theoretical framework that can guide and enhance instructional practices in Taiwanese PE classrooms.

The other major finding of the study is that compared to traditional PE, the SDT-guided PE instruction created more favorable motivational responses among students over six weeks of intervention. Specifically, the students in the experimental group significantly increased their intrinsic motivation, whereas those in the control group did not. This finding is consistent with other intervention studies conducted at the secondary school level (Chatzisarantis and Hagger, 2009; Prusak et al., 2004; Tessier et al., 2010). However, unlike previous research (e.g., Prusak et al., 2004), no significant increases in motivation variables such as identified motivation, external regulation, and amotivation were observed in this study. This finding is informative and encouraging for future research. Specifically, it confirmed the tenability and efficacy of the SDT in that providing students with support for their innate needs (such as perceived autonomy)

can significantly impact students' motivational responses (Bryan and Solmon, 2007; Deci and Ryan, 1985; Ntoumanis, 2001; Sun and Chen, 2010). In line with previous research (Chatzisarantis and Hagger, 2009; Lonsdale et al., 2013; Prusak et al., 2004; Tessier et al., 2010), this finding reinforces the importance of affording students choices and autonomy in PE lessons in both western and Taiwanese societies. The positive outcome of this study also shows how easy it is for teachers to make instructional changes to their lessons that can result in positive meaningful student responses. Most importantly, the significant change observed in motivational responses in this project was that of intrinsic motivation: the highest level of motivation. This means that as result of increased autonomy support, the Taiwanese students increased their intrinsic motivation (i.e., enjoying the PE lessons for their sake). Given the importance of fostering self-determined motivation (intrinsic motivation in particular) in PE (Chen and Ennis, 2009; Cox et al., 2008), the finding from the present study bears important theoretical and practical implications to curriculum and instruction in PE. Future research and practice are encouraged to utilize the SDT as the theoretical framework to create and tailor PE lessons to stimulate and foster intrinsic motivation in students. Teachers are strongly encouraged to be supportive so students could have positive and high quality learning experiences in each PE lesson.

This study's strength lies in its research design. At baseline, the experimental group and control group demonstrated similar characteristics. Potentially confounding variables were controlled for before the start of the experiment. In addition, instruments with sound validity and reliability were utilized in the study to collect data. For these reasons, changes by group can be attributed to manipulations of the PE classes. The study also acknowledges that it is limited because it was conducted in a single elementary school. The results would be stronger if data were collected from more classes in a variety of schools (e.g., urban versus suburban). Thus, the findings may not be generalizable to school settings with various characteristics. We also acknowledge that autonomy support could be manipulated in ways beyond providing students choices for selections of content and learning tasks. Autonomy support could be reflected in all aspects of the teaching (e.g., task structure, task presentation, class management, evaluation, etc.) at various stages (i.e., planning, teaching, post-teaching stages). For example, allowing students to formulate a group for team-based learning, or incorporating peer evaluation could be perceived as autonomy supportive in PE classes. Furthermore, this study only examined the effect of autonomy support on students' self-determined motivation. We would like to acknowledge that self-determined motivation is impacted by the level of satisfaction for all three innate psychological needs (i.e., competence, autonomy, and relatedness). Future intervention studies should examine ways to provide support to satisfy these needs so that students could be situated in learning situations where they have optimal opportunities to enjoy the learning experiences and make good progress towards instructional objectives and goals. Last but not the least, the present

study used questionnaires for measurement. Issues with using self-report instruments have been widely recognized by social science researchers; and alternative measures such as observation and behavioral protocols have been used in motivation research. However, as mentioned above, the questionnaires used in this study are validated and have shown sound psychometric qualifications.

## Conclusion

Guided by the framework of the SDT, this study successfully manipulated the PE lessons by supporting students with more autonomy. The changes made by the PE teachers were recognized by students, who perceived and experienced increased levels of autonomy originated from both the teacher's teaching behaviors as well as from the PE classroom overall. The intervention significantly enhanced students' intrinsic motivation, which is viewed as the highest level of motivation in all situations. Future research is encouraged to design and evaluate SDT-guided interventions in elementary schools of various characteristics in Taiwan and other societies. Future research in elementary school PE settings should also examine learning- or behavior-related outcomes (e.g., PA, knowledge and skill acquisition), in addition to motivational responses (e.g., intrinsic motivation), attributable to SDT-guided interventions.

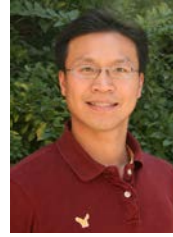
## References

- Bassett, D.R., Fitzhugh, E.C., Heath, G.W., Erwin, P.C., Frederick, G.M., Wolff, D.L. and Stout, A.B. (2013) Estimated energy expenditures for school-based policies and active living. *American Journal of Preventive Medicine* **44**(2), 108-113.
- Braithwaite, R., Spray, C.M. and Warburton, V.E. (2011) Motivational climate interventions in physical education: A meta-analysis. *Psychology of Sport and Exercise* **12**(6), 628-638.
- Bryan, C.L. and Solmon, M.A. (2007) Self-determination in physical education: Designing class environments to promote active lifestyles. *Journal of Teaching in Physical Education* **26**, 260-278.
- Chatzisarantis, N.L.D. and Hagger, M.S. (2009) Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health* **24**(1), 29-48.
- Chen, A. and Ennis, C.D. (2009) Motivation and achievement in physical education. In: *Handbook of motivation at school*. K. Ed: Wigfield, W.A. New York: Routledge. 553-574.
- Cox, A.E., Smith, A.L. and Williams, L. (2008) Change in physical education motivation and physical activity behavior during middle school. *Journal of Adolescent Health* **43**(5), 506-513.
- Cox, A.E., Ullrich-French, S., Madonia, J. and Witty, K. (2011) Social physique anxiety in physical education: Social contextual factors and links to motivation and behavior. *Psychology of Sport and Exercise* **12**(5), 555-562.
- Cox, A.E., Ullrich-French, S. and Sabiston, C.M. (2013) Using motivation regulations in a person-centered approach to examine the link between social physique anxiety in physical education and physical activity-related outcomes in adolescents. *Psychology of Sport and Exercise* **14**(4), 461-467.
- Deci, E.L. and Ryan, R.M. (1985) *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- Hagger, M.S., Chatzisarantis, N.L.D., Barkoukis, V., Wang, C.K.J. and Baranowski, J. (2005) Perceived autonomy support in physical education and leisure-time physical activity: A cross-cultural evaluation of the trans-contextual model. *Journal of Educational Psychology* **97**(3), 376-390.
- Lim, B.S.C. and Wang, C.K.J. (2009) Perceived autonomy support, behavioural regulations in physical education and physical activity intention. *Psychology of Sport and Exercise* **10**(1), 52-60.
- Lonsdale, C., Rosenkranz, R.R., Sanders, T., Peralta, L.R., Bennie, A., Jackson, B., Taylor, I.M. and Lubans, D.R. (2013) A cluster randomized controlled trial of strategies to increase adolescents' physical activity and motivation in physical education: Results of the Motivating Active Learning in Physical Education (MALP) trial. *Preventive Medicine* **57**(5), 696-702.
- McDavid, L., Cox, A.E. and McDonough, M.H. (2014) Need fulfillment and motivation in physical education predict trajectories of change in leisure-time physical activity in early adolescence. *Psychology of Sport and Exercise* **15**(5), 471-480.
- Nader, P.R., Bradley, R.H., Houts, R.M., McRitchie, S.L. and O'Brien, M. (2008) Moderate-to-vigorous physical activity from ages 9 to 15 years. *The Journal of the American Medical Association* **300**(3), 295-305.
- Ntoumanis, N. (2001) A self-determination approach to the understanding of motivation in physical education. *British Journal of Educational Psychology* **71**, 225-242.
- Ntoumanis, N. (2005) A prospective study of participation in optional school physical education using a self-determination theory framework. *Journal of Educational Psychology* **97**(3), 444-453.
- Pate, R.R., O'Neil, J.R. and McIver, K.L. (2011) Physical activity and health: Does physical education matter? *Quest* **63**(1), 19-35.
- Pintrich, P.R. (2003) A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology* **95**(4), 667-686.
- Prusak, K.A., Treasure, D.C., Darst, P.W. and Pangrazi, R.P. (2004) The effects of choice on the motivation of adolescent girls in physical education. *Journal of Teaching in Physical Education* **23**(1), 19-29.
- Shen, B., McCaughtry, N., Martin, J. and Fahlman, M. (2009) Effects of teacher autonomy support and students' autonomous motivation on learning in physical education. *Research Quarterly for Exercise and Sport* **80**(1), 44-53.
- Shen, B., McCaughtry, N., Martin, J.J., Fahlman, M. and Garn, A.C. (2012) Urban high-school girls' sense of relatedness and their engagement in physical education. *Journal of Teaching in Physical Education* **31**(3), 231-245.
- Standage, M., Duda, J.L. and Ntoumanis, N. (2006) Students' motivational processes and their relationship to teacher ratings in school physical education: A self-determination theory approach. *Research Quarterly for Exercise and Sport* **77**(1), 100-110.
- Sun, H. and Chen, A. (2010) A pedagogical understanding of the self-determination theory in physical education. *Quest* **62**(4), 364-384.
- Taylor, I.M., Ntoumanis, N., Standage, M. and Spray, C.M. (2010) Motivational predictors of physical education students' effort, exercise intentions, and leisure-time physical activity: A multilevel linear growth analysis. *Journal of Sport and Exercise Psychology* **32**(1), 99-120.
- Tessier, D., Sarrazin, P. and Ntoumanis, N. (2010) The effect of an intervention to improve newly qualified teachers' interpersonal style, students motivation and psychological need satisfaction in sport-based physical education. *Contemporary Educational Psychology* **35**(4), 242-253.
- Todorovich, J.R. and Curtner-Smith, M.D. (2002) Influence of the physical education classroom motivational climate on sixth grade students' task and ego orientations. *European Physical Education Review* **8**(2), 119-138.
- Todorovich, J.R. and Curtner-Smith, M.D. (2003) Influence of the physical education classroom motivational climate on third grade students' task and ego orientations. *Journal of Classroom Interactions* **38**(1), 36-46.
- Troiano, R.P., Berrigan, D., Dodd, K.W., Masse, L.C., Tilert, T. and McDowell, M. (2008) Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise* **40**(1), 181-188.
- Wallhead, T., Garn, A.C., Vidoni, C. and Youngberg, C. (2013) Game play participation of unmotivated students during sport education. *Journal of Teaching in Physical Education* **32**, 149-165.

### Key points

- The SDT is a relevant theoretical framework for elementary school physical education.
- Using the quasi-experimental research design, this study is one of the earliest studies supporting that elementary school PE teachers can manipulate the instructional context using the SDT to increase students' perceived autonomy and intrinsic motivation.
- Increasing students' perceived autonomy may not lead to significant changes in other SDT constructs (i.e., amotivation, external regulation, introjected regulation, and identified regulation).

### AUTHOR BIOGRAPHY



#### Yu-Kai CHANG

##### Employment

Graduate Institute of Athletics and Coaching Science at National Taiwan Sport University, Taiwan

##### Degree

PhD

##### Research interest

Specializes in exercise psychology and cognition.

**E-mail:** yukaichangnew@gmail.com



#### Senlin CHEN

##### Employment

Department of Kinesiology at Iowa State University, USA

##### Degree

PhD

##### Research interest

Specializes in pedagogical kinesiology

**E-mail:** slchen11@iastate.edu



#### Kun-Wei TU

##### Employment

Graduate Institute of Athletics and Coaching Science at National Taiwan Sport University, Taiwan

##### Degree

MS

##### Research interest

Specializes in exercise psychology

**E-mail:** yowe601119@livemail.tw



#### Li-Kang CHI

##### Employment

Department of Physical Education, National Taiwan Normal University, Taiwan

##### Degree

PhD

##### Research interest

Specializes in exercise psychology

**E-mail:** likang.chi@gmail.com

#### ✉ Senlin Chen, PhD

255 Forker Building, Iowa State University, Ames, Iowa, USA 50011.