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Normative and Intraindividual Changes in Physical Education Motivation Across the Transition to Middle School: A Multilevel Growth Analysis

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According to self-determination theory, motivation is multidimensional, with motivation regulations lying along a continuum of self-determination (Ryan & Deci, 2007). Motivation regulations associate with important affective and behavioral outcomes both within and outside of physical activity settings such as physical education. However, there is little longitudinal data examining changes in motivation regulations, especially during the entry into and through middle school. This study used multilevel modeling (MLM) to identify changes in motivation regulations and predictors of change for students into and across the transition to middle school. Students ($N = 353$) in physical education classes completed questionnaires of psychological need variables, mastery climate, teacher support, and motivation regulations during the spring semester for three consecutive years starting in either fifth or sixth grade. Results demonstrate normative decreases in perceptions of competence ($\gamma = -0.06$, $p < .01$), relatedness ($\gamma = -0.08$, $p < .05$), mastery climate ($\gamma = -0.28$, $p < .01$), teacher support, ($\gamma = -0.18$, $p < .01$), intrinsic motivation ($\gamma = -0.09$, $p < .01$) and identified regulation ($\gamma = -0.09$, $p < .01$) and increases in external regulation ($\gamma = 0.10$, $p < .01$). Demographic and theoretical predictors were tested to explain between-student variability in intercepts and linear change. Psychological need satisfaction, mastery climate, and teacher support predicted ($p < .05$) motivation regulation change consistent with theory and/or research. Adaptive social contextual perceptions and perceptions of competence and relatedness are linked with adaptive motivational trajectories in a U.S. middle school sample.

Keywords: self-determination theory, physical activity, adolescents, motivational climate

Physical education is a promising mechanism for addressing lower physical activity levels during older childhood and adolescence (Pate, Davis, Robinson, Stone, McKenzie, & Young, 2006) spurring interest in how physical education experiences can translate into positive physical activity attitudes, perceptions, and behaviors outside of the school context (e.g., Standage, Gillison, Ntoumanis, & Treasure, 2012; Taylor, Ntoumanis, Standage, & Spray, 2010). This growing body of work has consistently supported the important role of autonomous (i.e., self-determined) motivation in physical education for predicting autonomous motivation for physical activity outside of school, intentions to be active in the future, health-related quality of life, fitness levels, physical self-concept and physical activity levels outside of school (e.g., Cox, Smith, & Williams, 2008; Hagger et al., 2009; Power, Ullrich-French, Steele, Daratha, & Bindler, 2011; Standage et al., 2012; Taylor, Ntoumanis, Standage, & Spray, 2010). However, little is known about how autonomous motivation in physical education changes during childhood and adolescence or the key factors explaining within-student fluctuations over time.

The transition from elementary to middle school is a critical period of development that has

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been largely overlooked in physical education research and happens to coincide with a decline in physical activity levels (Wall, Carlson, Stein, Lee, & Fulton, 2011). In the United States, this transition typically occurs when students move from fifth grade into sixth grade. Students experience changes in the overall school structure, class size and organization, teaching strategies, academic standards, and teacher expectations when they begin middle school and these changes can have significant motivational implications (Eccles, 2004). During this period of transition, young adolescents are simultaneously undergoing biological, cognitive, and psychological change (Rice & Dolgin, 2005) that may result in motivational changes not seen with younger or older students. The negotiation of this transition has implications for developmental trajectories that reflect both normative change as well as individual differences (Eccles, 2004; Rudolph, Lambert, Clark, & Kurlakowsky, 2001). Normative findings from academic settings suggest overall declines in academic achievement, perceptions of competence, intrinsic motivation, and self-concept across the transition to middle school (Eccles, 2004; Fredericks & Eccles, 2002; Lepper, Corpus, & Iyengar, 2005). However, individual differences across students are evident and can represent both risk (e.g., perceived stress) and protective (e.g., self-regulatory beliefs) factors with regard to negotiating the transition to middle school (Rudolph et al., 2001).

Although physical education research has not been conducted on the transition into middle school, normative changes in motivation-related variables during early adolescence have been found in research on physical education (Barkoukis, Ntoumanis, & Thogersen-Ntoumani, 2010; Gao, Lee, Solmon, & Zang, 2009; Ntoumanis, Barkoukis, & Thogersen-Ntoumani, 2009). For example, Gao et al. found that from sixth/seventh grade to seventh/eighth grade, middle school students reported lower expectancy-related beliefs, value, and self-efficacy in physical education. Barkoukis et al. reported average declines in enjoyment of physical education and increases in boredom across the 3 years of junior high school. Collectively, this research indicates normative decreases in positive motivational experiences in physical education over the middle school/junior high school years.

Self-determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2000) is a useful framework to examine change in student physical education motivation across the transition to middle school because autonomous motivation has been identified as such an important link to adaptive cognitive, affective and behavior outcomes outside of physical education (see Ntoumanis, 2012). SDT proposes that students have different reasons or motivation regulations for participating in physical education, which can range from being completely autonomous (e.g., the enjoyment of physical activity) to completely controlling (e.g., the avoidance of punishment). Intrinsic motivation is completely autonomous or self-determined and is characterized by behavior reflecting the enjoyment and stimulation of the activity itself. Four types of extrinsic motivation follow, in order of declining degree of autonomy: integrated (i.e., doing an activity because it has been assimilated within one's sense of self), identified (i.e., doing an activity because it is valued), introjected (i.e., doing an activity to avoid guilt or gain pride), and external (i.e., doing an activity to satisfy an external contingency) regulations. Integrated and identified regulations are considered autonomous, whereas introjected and external regulations are considered controlling because the reasons for participation have not been endorsed by the individual. Finally, amotivation is considered unregulated and is reflected in the absence of intention, value, or personal causation (Ryan & Deci, 2007).[1]

There is much interest in the factors that support autonomous motivation given the range of adaptive outcomes linked with this form of motivation (Ryan & Deci, 2007). SDT has identified the satisfaction of three basic psychological needs (Deci & Ryan, 2000) as the most proximal precursors to autonomous motivation. These include the need to feel effective (i.e., competence) in one's environment, volitional or perceive one has choice (i.e., autonomy), and socially connected or like one belongs (i.e., relatedness). Additionally, a variety of social-contextual variables can support or thwart these basic psychological needs. There is good sup-

[1] Integrated regulation and amotivation are not discussed further or examined in this study because they did not emerge as relevant reasons underlying achievement behaviors in Ryan and Connell's (1989) research with older children. In addition, research has demonstrated that integrated reasons may not emerge until adulthood (Vallerand, 1997).

port for the theorized positive relationships among positive perceptions of the social context, greater perceptions of competence, autonomy and relatedness and more autonomous motivation in the physical education setting (e.g., Cox & Williams, 2008; Ntoumanis, 2001; Ntoumanis et al., 2009; Standage, Duda, & Ntoumanis, 2003, 2005; Taylor et al., 2010). Though most of this research has been cross-sectional in nature, recent studies have begun to test these relationships over time.

Recent longitudinal research with Greek junior high school physical education students (Ntoumanis et al., 2009) using MLM documented that intrinsic motivation, identified regulation, and perceived relatedness declined significantly on average across the 3 years of junior high school (i.e., from 13–15 years) while amotivation increased. There also was significant between-student variability in change in all motivation regulations, which means that there was significant variability in the individual change patterns between different students (sometimes referred to as intraindividual variability or variability in within-student change). The authors suggest that even when the sample average did not change (e.g., introjected regulation), some individual students did experience change. Further, Ntoumanis et al. (2009) found that change in perceptions of competence explained some of the between-student variability in change in motivation regulations across junior high school. Specifically, decreasing competence perceptions were associated with significant increases in external regulation and decreases in identified regulation. Change in perceptions of relatedness did not explain change in motivation regulations, and perceived autonomy was not included in the main analyses owing to low internal consistency reliability.

One explanation for change in these motivation variables across junior high school is that the motivational climate established in the physical education setting becomes increasingly competitive and ego-involving (i.e., success is based on social comparisons and normative standards) as students move up in grade level (Barkoukis et al., 2010; Ntoumanis et al., 2009). Physical education research has documented increased perceptions of an ego-involving (i.e., performance) climate and decreased perceptions of a task-involving (i.e., mastery; self-referenced success and cooperation is rewarded and valued) climate across the junior high school years (i.e., 12–15 years; Barkoukis et al., 2010; Ntoumanis et al., 2009). In these studies, perceived task-involving climate was a positive predictor of enjoyment, perceived competence, and perceived relatedness at time 1 and negative predictor of boredom, whereas perceived ego-involving climate was a positive predictor of boredom at time 1. However, within-student change in perceptions of task- and ego-involving climates were not significant predictors of within-student change in various motivation variables including need satisfaction and motivation regulations (Ntoumanis et al., 2009). It should be noted that in the Ntoumanis et al. study, no predictors of change were included for perceived competence, amotivation, intrinsic motivation, and introjected regulation because of nonsignificant average change over time and/or nonsignificant between-student variability in change over time. These studies extend the physical education literature on the relationships among motivational climate, need satisfaction, and motivation regulations by attempting to predict between-student variability in change over time; however, these longitudinal results do not support relationships between changes in motivational climate and changes in motivation-related variables, thus failing to corroborate the cross-sectional literature that illustrates the positive role of a task-involving climate (e.g., Cox & Williams, 2008; Ntoumanis, 2001; Standage et al., 2003).

Given the limited longitudinal evidence supporting the predictive utility of the motivational climate created by the physical education teacher, other aspects of the social climate may be useful to explore. Though it has received less attention than supports for competence and autonomy, involvement has been highlighted as an important social variable for nurturing feelings of relatedness (Connell & Wellborn, 1991; Mageau & Vallerand, 2003). Involvement reflects many relational components including caring, encouragement, support and emotional connection. Cross-sectional studies have supported the important role of having a caring and emotionally supportive leader (e.g., teacher, coach) in predicting key motivation variables (e.g., Cox & Williams, 2008; Fry & Gano-Overway, 2010; Wilson et al., 2012). Specifically, perceived emotional support from one's physical education teacher has been positively linked to all

three psychological needs and autonomous motivation (Cox, Duncheon & McDavid, 2009; Cox & Ullrich-French, 2010; Cox & Williams, 2008). In a youth sport setting, greater perceptions of a caring climate (i.e., sense of being valued, cared for and respected) positively predicted enjoyment and commitment to sport (Fry & Gano-Overway, 2010). In a rare longitudinal study, Wilson et al. (2012) found that perceptions of physical education teachers acting with care and empathy to empower their students (i.e., transformational teaching) at Time 1 positively predicted autonomous motivation and engagement at Time 2 in students in Grades 5–7. Furthermore, psychological need satisfaction partially mediated these relationships. Therefore, the degree to which students perceive their teacher as being caring and emotionally supportive may be an important predictor of change in motivation variables during the transition into and across the middle school years.

Though research is now emerging on how motivation regulations change across junior high school and key predictors of within-student change in motivation (e.g., Ntoumanis et al., 2009), there has been no research focused on describing trajectories of change in motivation regulations, psychological need satisfaction variables, and key elements of the social context across the transition from elementary to middle school using a SDT framework. The purpose of this study was to describe change in motivation regulations and key theoretical antecedents of that change in a U.S. sample of students making the initial transition into middle school and across the middle school years. Our first aim was to test for normative change over a 2-year period in the social contextual variables of mastery climate and teacher support, psychological needs, and motivation regulations using a MLM approach. Our second aim was to examine whether demographic variables and theoretical predictors explained variability in initial mean levels or change over a 2-year period. Based on SDT, time-varying social context variables were tested as predictors of psychological needs and then also were direct predictors of motivation regulations because social contextual variables have exhibited direct relationships with motivation (e.g., Cox & Williams, 2008; Wilson et al., 2012). Time-varying psychological needs variables were also tested as predictors of motivation regulations, based on SDT. We hypothesized decreases in perceived teacher support, mastery climate, psychological need satisfaction, intrinsic motivation, and identified regulation and that these average changes would be greater for students making the initial transition into middle school (i.e., fifth graders) compared with those moving through middle school (i.e., sixth graders). We anticipated significant between-student variability in change in these variables over the 2-year period. We also expected that (1) perceived mastery climate and teacher support would positively predict initial mean levels of psychological need satisfaction and autonomous motivation and negatively predict controlling motivation, (2) increases in mastery climate and teacher support would predict increases in psychological need satisfaction and autonomous forms of motivation and decreases in controlling forms of motivation, (3) psychological need satisfaction would positively predict initial mean levels of autonomous motivation and negatively predict controlling motivation, and (4) increases in psychological need satisfaction would predict increases in autonomous forms of motivation and decreases in controlling forms of motivation.

Method

Participants and Procedure

Students in the fifth grade (final year of elementary school) and sixth grade (first year of middle school) were recruited from physical education classes in the Midwest region of the United States following approval from the institutional review board and school administrators. Students with parental consent and assent completed the study questionnaire during the spring semester of the school year for three consecutive years.[2] Data from the first year (Cox & Williams, 2008) and the last 2 years (Cox et al., 2008) of this study have been published elsewhere. One research assistant read the survey aloud to the fifth grade students. Students in grades six and higher read the survey on their own and research assistants were

[2] Some students participated in physical education during the fall semester in middle school. Data from students (n = 219) at this time point were excluded from this study so that all data collection periods were spaced equally at 1 year apart.

present to address questions and provide instructions. The sample included 353 students ($n = 181$ fifth grade cohort, $n = 172$ sixth grade cohort; (initial $M_{age} = 11.36$; $SD_{age} = 0.68$). Students were primarily Caucasian (84%; 1.7% Black; 0.6% Asian; 2.8% American Indian; 3.1% Latino; 4.5% other) and 55% female. Students participated in physical education classes throughout the school year for approximately 60 min per week in elementary school (i.e., fifth grade) and 40 min every other school day during middle school (i.e., sixth–eighth grade).

Measures

Motivation regulations. A modified version of the Academic Self-Regulation Questionnaire (Ryan & Connell, 1989) assessed motivation regulations in the physical education (PE) setting. Three stems were modified from the original scale to, "Why do I take part in the physical activities in PE," "Why do I try hard in PE," and "Why do I try to do well in PE," to capture multiple behaviors. Each stem is followed by eight different reasons that reflect the different types of motivation. Six items each represented intrinsic motivation, and identified, introjected and external regulations. Students responded on a 4-point scale ranging from *Not at all true* (1) to *Very true* (4). Example items include, "Because it's fun" (intrinsic motivation), "Because I want to learn new things" (identified regulation), "Because I feel disappointed with myself when I don't try" (introjected regulation), and "So that the PE teacher won't yell at me" (external regulation). The means of the items from each motivation subscale were calculated to create individual motivation regulation scores. Physical education research using similarly modified versions of this measure document internal consistency reliability and construct validity to support the use of subscale scores (Ntoumanis, 2005; Standage et al., 2005).

Perceived competence. The 6-item athletic competence subscale of Harter's (1985) Self-Perception Profile for Children was modified by adding "in PE" to items to assess perceived physical ability in physical education class. In item #3, "physical activities" was used instead of "sports" to be inclusive of all activities in physical education. This scale uses a structured-alternative format (e.g., "Some kids do very well at all kinds of sports in P.E., BUT Other kids don't feel that they are very good when it comes to sports in P.E."—select one, then indicate *sort of* or *really* true) and items are scored from 1 to 4, with higher values representing higher perceived competence. Reliable and valid scores have been obtained with similarly modified versions of the measure (Ridgers, Fazey, & Fairclough, 2007).

Perceived autonomy. Four of the five items used by Standage et al. (2003) to assess perceptions of choice in physical education were modified (i.e., "skills" was changed to "physical activities") to measure perceived autonomy in this setting. One item ("I participate in PE because I want to") was too conceptually similar to the intrinsic motivation items and was therefore not included. Students responded to items (e.g., "I can decide which activities I want to practice") on a 5-point scale that ranged from *Strongly disagree* (1) to *Strongly agree* (5). Standage et al., (2003) demonstrated support for the internal consistency and validity of scale scores with the 5-item version of the scale.

Perceived relatedness and teacher support. Students completed a modified version of the Psychological Sense of School Membership Scale (Goodenow, 1993). An exploratory factor analysis on this scale modified for the PE setting (see Cox & Williams, 2008) revealed three factors reflecting: perceptions of teacher support (i.e., emotional support; 6 items), perceived relatedness or belonging (5 items), and feelings of alienation (3 items). The items reflecting perceived teacher support (e.g., "I can talk to my PE teacher if I have a problem") and relatedness (e.g., "It is hard for people like me to be accepted in my P.E. class"—reverse scored) were used in the main analyses in this study. Participants responded to these items on a 5-point scale ranging from "*Not at all true of me*" (1) to "*Very true of me*" (5). These subscale scores have been used in previously published research using portions of these data (Cox et al., 2008; Cox & Williams, 2008), providing initial internal consistency reliability and construct validity evidence to support the use of the scale scores. In addition, items from this scale have been used to assess feelings of belonging in a sport setting (Allen, 2006).

Mastery motivational climate. The "promotion of learning by teacher" (4 items) subscale from the Perception of Motivational Climate Scale (PMCS) (Biddle et al., 1995) was

used to assess students' perceptions of a mastery climate.[3] In each item, the word "pupils" was replaced with "students" to make the PMCS more appropriate for a sample in the United States. Participants responded on a 5-point scale ranging from "*Don't agree at all*" (1) to "*Agree completely*" (5). This subscale has demonstrated adequate internal consistency, factorial, and construct validity in samples of young adolescent (i.e., 12–14 years) British students (Biddle et al., 1995; Standage et al., 2003).

Data Analysis

Data screening included examination of univariate and multivariate normality and outliers. Internal consistency reliability (Cronbach's alpha) was also assessed for scores on each measure. Descriptive statistics (i.e., means, standard deviations) were calculated to describe the sample. To assess the main study purpose we used MLM based on Singer and Willett (2003) with level 1 representing the repeated observation of motivation regulations over time within students and level 2 representing between-student variability. Analyses exploring school and grade nesting were conducted; however, there was no significant between-school or class variance. Therefore, these levels were not included in the main analyses. A series of models were tested with each psychological need and each motivation regulation serving as the dependent variable in its own model. Model 1 was an unconditional model that only included an intercept as the independent variable representing fixed (average) and random (variance) effects to examine variation in the intercept (i.e., variable mean) or initial level of each variable. The second model included the slope (i.e., rate of linear change) or growth trajectory as fixed and random effects. These two models were compared to calculate intraclass correlations (ICCs) and within-student variance explained by including the slope (R^2) to help support whether MLM was appropriate. When significant variance was explained by time and ICCs suggest nesting (i.e., larger ICCs inflate standard error and require a MLM approach, see Bloom, 2005), we included both levels 1 and 2 in subsequent conditional analyses. Conditional models included predictor variables to explain significant variability. Predictors included the demographic variables of school, cohort (starting in fifth or sixth grade), and gender, and theoretically based time-varying predictors (mastery climate and teacher support predicting psychological needs; mastery climate, teacher support, perceived competence, autonomy, and relatedness predicting motivation regulations).

To examine time varying predictors, we followed recommendations by Raudenbush and Bryk (2002) to transform the time-varying predictors to reduce bias in the level 1 predictor (for a similar approach see Taylor et al., 2010). Each time varying predictor was nested within students over time. Each predictor variable was group mean centered (i.e., centered around each participant's unique mean of each predictor variable averaged over time) and entered into level 1 to represent within-student change. By using group mean centering the invariant effects of each participant are removed, leaving only deviations from each participant's unique mean across time. Each individual's average over time for each predictor variable was also entered into level 2 to (1) predict the intercept and (2) the interaction with the linear change growth factor was entered to predict the slope capturing between-student differences in change. Analyses were completed with IBM SPSS Statistics 20.0 (SPSS Inc., Chicago, IL). Parameter estimates are reported as unstandardized estimates.

Results

Descriptive Statistics

The effective sample size was 353 for all analyses. Participants were drawn from data collections during the spring at time 1 (n = 343), time 2 (n = 303), and time 3 (n = 250). Analyses did not reveal significant differences between those missing a time point, and those who had complete data across three time points on demographics or on study constructs. Therefore, we used Maximum Likelihood Estimation, which is robust at handling data missing across time points when the assumption of missing at random is justifiable. Because so few (3.6%)

[3] The "promotion of comparison by teacher" subscale was used to assess perceived performance climate but demonstrated poor internal consistency reliability in earlier phases of this project and was not used (see Cox & Williams, 2008).

cases were missing data at the item level, we chose not to impute data for these cases. All constructs demonstrated good reliability ($\alpha \geq .70$; see Table 1). Data screening procedures did not identify any variables as nonnormal (skewness/kurtosis >2). There were only 21 (5.9%) univariate ($z > \pm 3.0$) but no multivariate (Mahalanobis D^2 meeting a $p < .001$ criterion) outliers identified. The results were consistent when conducted with and without outliers; therefore all cases were retained. Descriptive statistics for study variables appear in Table 1.

Multilevel Modeling

Unconditional models testing variation in intercepts and slopes. First, unconditional models, examining intercepts (initial mean values) followed by the inclusion of linear slopes (i.e., rates of change), were examined for each motivation regulation (see Table 2). Mastery climate and teacher support both started moderately high ($\gamma = 3.98$ and $\gamma = 4.00$, respectively) and declined significantly ($p < .01$, $\gamma = -0.28$ and $\gamma = -0.18$, respectively) over time. For both, there was significant ($p < .01$) between-student variance in the intercept and slope. The R^2 values indicate that 35% and 24% of within-student variation in mastery climate and teacher support, respectively, was accounted for by the linear change growth factor (slope).

Perceived competence and relatedness started, on average, relatively high ($\gamma = 3.02$ and $\gamma = 3.99$, respectively), whereas autonomy started at a moderate level ($\gamma = 2.59$). Competence ($\gamma = -0.06$) and relatedness ($\gamma = -0.08$) both declined significantly ($p < .05$) on average. There was significant variability ($p < .05$) in both the intercept and slope for competence and relatedness. There was only significant ($p < .01$) variability in the intercept for autonomy but no average change over time and no between-student variability in change. Therefore, we did not predict change in autonomy. The R^2 values indicate that 12–24% of within-student variation in psychological needs was accounted for by the linear change growth factor.

Intrinsic motivation and identified regulation both started out high ($\gamma = 3.38$ and $\gamma = 3.27$) and declined significantly ($p < .01$, $\gamma = -0.09$ and $\gamma = -0.09$) over time. For both, there was significant ($p < .05$) between-student variance in the intercept and slope. There was also significant ($p < .05$) covariance between the slope and intercept indicating that those with lower initial scores on intrinsic motivation or identified regulation experienced higher rates of growth (i.e., decline). Introjected regulation started out moderately high ($\gamma = 2.79$), but the slope was not significant, indicating no significant average change. There was significant variance ($p < .05$) in intercept and slope between students, but the covariance between the slope and intercept was not significant. Finally, external regulation had a moderately low initial value ($\gamma = 2.20$) and increased significantly ($p < .01$, $\gamma = 0.10$) over time. There was also significant ($p < .01$) between-student variance in the intercept and slope, and the covariance between the slope and intercept indicating that those with lower initial scores experienced higher rates of growth (i.e., increase). The R^2 values indicate that 13–25% of within-student variation in mo-

Table 1
Mean, Standard Deviation, and Internal Consistency Reliability For Study Variables

Variable	Scale range	Time 1			Time 2			Time 3		
		Mean (*SD*)	*N*	α	Mean (*SD*)	*N*	α	Mean (*SD*)	*N*	α
Intrinsic motivation	1–4	3.36 (.69)	343	.90	3.34 (.67)	303	.91	3.20 (.72)	249	.92
Identified regulation	1–4	3.26 (.63)	343	.85	3.19 (.63)	303	.84	3.11 (.69)	250	.90
Introjected regulation	1–4	2.79 (.63)	342	.73	2.81 (.65)	303	.77	2.86 (.68)	249	.83
External regulation	1–4	2.20 (.68)	343	.73	2.30 (.62)	303	.70	2.40 (.61)	250	.70
Competence	1–4	3.02 (.63)	342	.73	2.97 (.67)	303	.77	2.91 (.67)	250	.79
Autonomy	1–4	2.60 (.94)	342	.71	2.53 (.91)	303	.75	2.53 (.89)	249	.76
Relatedness	1–5	4.01 (.84)	341	.80	3.89 (.93)	303	.86	3.89 (.89)	250	.85
Mastery climate	1–5	3.98 (.72)	342	.84	3.69 (.77)	303	.87	3.45 (.83)	250	.88
Teacher support	1–5	4.00 (.90)	342	.83	3.33 (1.21)	303	.84	3.21 (1.30)	250	.83

Table 2
Linear Change in Study Variables Over Three Time Points

Variable	Fixed effects		Within-student variance	Between-student variance			ICC	R^2
	Intercept	Slope	Intercept variance (residual)	Intercept variance	Slope variance	Cov intercept/ slope		
Intrinsic	3.38**	−.09**	.26**	.20**	.08**	−.05*	.31	.24
Identified	3.27**	−.09**	.23**	.16**	.07**	−.04*	.27	.25
Introjected	2.79**	.02	.27**	.13**	.04*	−.02	.28	.13
External	2.20**	.10**	.19**	.26**	.06**	−.07**	.39	.25
Competence	3.02**	−.06**	.16**	.23**	.04*	−.01	.53	.18
Autonomy	2.59**	−.05	.53**	.32**	.08	−.07	.28	.12
Relatedness	3.99**	−.08*	.35**	.39**	.11**	−.06	.42	.24
Mastery climate	3.98**	−.28**	.29**	.23**	.09**	−.03	.29	.35
Teacher support	4.00**	−.18**	.49**	.34**	.14**	−.08	.27	.24

Note. ICC = intraclass correlation; R^2 = percentage of within-student variation accounted for by linear change (slope). Reported estimates are unstandardized.
* $p < .05$. ** $p < .01$.

tivation regulations was accounted for by the linear change growth factor.

To test for nonlinear growth patterns, quadratic change was entered into the models. Results showed that quadratic time trajectories were nonsignificant ($p > .05$) for all variables, except for intrinsic motivation. The quadratic trajectory was marginally significant ($\gamma = -0.07$, $p = .046$); however, the model fit parameters were not significantly changed with the addition of the quadratic term, $\chi^2(1) = 5.93$, $p > .05$; $\Delta AIC = .07$; $\Delta BIC = 14$. This indicates there may be some acceleration of the growth rate (decline) of intrinsic motivation over time. However, because the quadratic term did not improve model fit we did not model quadratic change. As such, all reference to change reflects linear change.

Given the significant between-student variability in both the intercept and slope for perceived competence and relatedness and all motivation regulations in the unconditional models, and ICCs ranging from .27 to .53, level 2 (i.e., student level) covariates were tested to predict remaining variability. We first tested models predicting each psychological need with the time-varying social climate variables of mastery climate and teacher support. Next, we tested models predicting each motivation regulation with the time-varying psychological need variables, mastery climate, and teacher support.

Conditional models including predictors of variance in intercepts and slopes. First, we examined whether within-student changes in perceived competence and relatedness across time were predicted by within-student changes in mastery climate and teacher support perceptions. Results appear in Table 3. Cohort and school were not significant covariates and therefore were dropped from the models.[4] Gender was significant for competence ($\gamma = -0.31$, $p < .01$) and relatedness ($\gamma = -0.22$, $p < .01$), suggesting that boys report higher perceptions of competence and relatedness compared with girls. Within-student changes in mastery climate ($\gamma = 0.16$, $p < .01$) and teacher support ($\gamma = 0.52$, $p < .01$) perceptions positively predicted within-student changes in perceived relatedness, teacher support perceptions ($\gamma = 0.16$, $p < .01$) also positively predicted changes in perceived competence. These findings mean that increases in mastery climate and teacher support perceptions associated with increases in these psychological needs. Between-person differences in mean perceived teacher support positively predicted differences in perceived competence ($\gamma = 0.20$, $p < .01$) and relatedness ($\gamma = 0.60$, $p < .01$) at the first time point. That

[4] Contact the first author for full results regarding demographic predictors.

Table 3
Predictors of Intercepts and Slopes of Psychological Needs

	Competence		Relatedness	
	γ	*SE*	γ	*SE*
Fixed effects				
Intercept	2.71**	.22	1.32**	.24
Slope	−0.06	.12	0.26	.15
Gender	−0.31**	.06	−0.22**	.07
Within-student changes				
Mastery climate	0.01	.03	0.16**	.03
Teacher support	0.16**	.02	0.52**	.03
Between-student differences				
Mean mastery climate	−0.08	.07	0.10	.08
Mean teacher support	0.20**	.05	0.60**	.06
Slope × gender	−0.06	.04	0.09	.05
Slope × mastery climate	0.01	.04	−0.06	.05
Slope × teacher	0.00	.03	−0.01	.04
Random effects	σ	*SE*	σ	*SE*
Within-student intercept variance	0.14**	.01	0.25**	.02
	τ	*SE*	τ	*SE*
Intercept variance	0.16**	.01	0.17**	.04
Slope variance	0.02	.01	0.03	.02
Covariance between intercept and slope	−0.01	.02	−0.02	.02
R_1^2	.13		.29	
R_2^2	.30		.56	

Note. R^2 values represent the proportional amount by which error variance is reduced from unconditional to conditional model at within- R_1^2 and between-student R_2^2 levels. Reported estimates are unstandardized.
* $p < .05$. ** $p < .01$.

is, those with higher perceptions of teacher support had higher perceived competence and relatedness at time one. No interactions emerged between mastery climate or teacher support with linear change, indicating that the relationships of mean mastery climate and teacher support perceptions to perceived competence and relatedness were constant across time. The R_1^2 and R_2^2 values indicate that compared with the unconditional models, the predictor variables reduced error variance by 13% and 29% at the within-student level and 30% and 56% at the between-student levels for competence and relatedness, respectively.

Next, we examined whether within-student changes in motivation regulations across time were predicted by within-student changes in psychological needs, mastery climate, and teacher support perceptions. Results appear in Table 4. Cohort, school, and gender were not significant covariates and therefore were dropped from the models, with the exception that gender was retained for the model predicting introjected regulation. Within-student changes in perceptions of competence, relatedness, mastery climate, and teacher support positively predicted within-student changes in intrinsic motivation ($\gamma = 0.21$, $\gamma = 0.22$, $\gamma = 0.19$, $\gamma = 0.18$, respectively, all $p < .01$) and identified regulation ($\gamma = 0.13$, $\gamma = 0.16$, $\gamma = 0.25$, $\gamma = 0.13$, respectively, all $p < .01$). These findings indicate that increases in these predictors associated with increases in autonomous forms of motivation. Between-student differences in mean perceptions of competence, mastery climate, and teacher support positively predicted differences in intrinsic motivation ($\gamma = 0.27$, $\gamma = 0.25$, $\gamma = 0.14$, respectively, all $p < .01$) and identified regulation ($\gamma = 0.21$, $\gamma = 0.31$, $\gamma = 0.14$, respectively, all $p < .01$). That is, those with higher perceptions of competence, mastery climate, and teacher support had higher intrinsic motivation and identified regulation at the first time point. Between-student differences in mean perceptions of relatedness also positively predicted differences in intrinsic motivation ($\gamma = 0.19$, $p < .01$), such that those with higher perceptions of relatedness had higher

Table 4
Predictors of Intercepts and Slope of Motivation Regulations

	Intrinsic motivation		Identified regulation		Introjected regulation		External regulation	
	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*
Fixed effects								
Intercept	0.32	.23	0.58*	.25	1.28**	.31	2.94**	.31
Slope	0.15	.15	0.13	.16	0.16**	.18	0.15	.18
Gender					0.08	.07		
Within-student changes								
Competence	0.21**	.03	0.13**	.03	0.04	.04	−0.11**	.04
Autonomy	0.04	.02	0.03	.02	0.02	.02	0.00	.02
Relatedness	0.22**	.03	0.16**	.03	0.07*	.03	−0.05	.03
Mastery climate	0.19**	.03	0.25**	.03	0.14**	.04	−0.06	.03
Teacher support	0.18**	.03	0.13**	.03	0.10**	.03	−0.10**	.03
Between-student differences								
Mean competence	0.27**	.06	0.21**	.06	0.08	.08	−0.11	.08
Mean autonomy	−0.04	.04	−0.05	.05	−0.04	.06	0.04	.06
Mean relatedness	0.19**	.06	0.10	.06	0.08	.08	−0.05	.07
Mean mastery climate	0.25**	.06	0.31**	.06	0.18*	.08	−0.06	.08
Mean teacher support	0.14**	.05	0.14**	.05	0.07	.07	−0.01	.06
Slope × gender					−0.10*	.05		
Slope × mean competence	−0.04	.04	−0.06	.04	0.01	.05	0.01	.05
Slope × mean autonomy	0.06*	.03	0.07*	.03	0.05	.03	−0.02	.03
Slope × mean relatedness	−0.01	.04	0.04	.04	−0.01	.05	−0.01	.05
Slope × mastery climate	−0.08	.04	−0.05	.04	−0.04	.05	0.04	.05
Slope × teacher	0.05	.03	−0.02	.03	−0.00	.04	−0.04	.04
Random effects	σ	*SE*	σ	*SE*	σ	*SE*	σ	*SE*
Within-student intercept variance	.16**	.01	.16**	.01	.24**	.02	.18**	.01
	τ	*SE*	τ	*SE*	τ	*SE*	τ	*SE*
Intercept variance	.08**	.02	.11**	.03	.16**	.04	.23**	.03
Slope variance	.02	.01	.04**	.01	.02	.02	.05**	.02
Covariance between intercept and slope	−.03*	.01	−.04**	.02	−.03	.02	−.06**	.02
R_1^2	.38		.30		.11		.06	
R_2^2	.60		.31		−.23		.15	

Notes. R^2 values represent the proportional amount by which error variance is reduced from unconditional to conditional model at within- R_1^2 and between-student R_2^2 levels. Reported estimates are unstandardized.
* $p < .05$. ** $p < .01$.

intrinsic motivation at time one. There were significant interactions between linear change and perceived autonomy predicting intrinsic motivation ($\gamma = 0.06$, $p < .05$) and identified regulation ($\gamma = 0.07$, $p < .05$), suggesting that higher perceived autonomy predicted increases in both forms of autonomous motivation. Plots of both interactions showed that slopes were positive regardless of level of autonomy perceptions, although none of the simple slopes were significant. This suggests negligible differences in linear change based on level of autonomy perceptions. No other interactions between psychological needs or social climate variables and linear change emerged, indicating that the relationships between mean perceived competence, relatedness, mastery climate, and teacher support with autonomous motivation were constant across time. The R_1^2 and R_2^2 values indicate that compared with the unconditional models, the predictor variables reduced the error variance by 38% and 30% at the within-student level and 60% and 31% at the between-student levels for intrinsic motivation and identified regulation, respectively.

Within-student change in perceived relatedness, mastery climate, and teacher support positively predicted changes in introjected regulation ($\gamma = 0.07$, $\gamma = 0.14$, $\gamma = 0.10$, respectively, all $p < .05$). Specifically, increases in perceived related-

ness, mastery climate, and teacher support predicted increases in introjected regulation. The only significant between-student difference predicting introjected regulation was mean perceived mastery climate ($\gamma = 0.18$, $p < .05$). Higher mastery climate perceptions predicted higher introjected regulation at time 1. There was a significant interaction of gender with linear change. The interaction ($\gamma = -0.10$, $p < .05$) suggests that females decreased in introjected regulation more over time compared with males; however, plotting the interaction revealed that although the female simple slope was negative and the male simple slope was positive, neither slope was significant, thus not revealing particularly meaningful differences. The R_1^2 and R_2^2 values indicate that compared with the unconditional models, the predictor variables reduced the error variance by 11% at the within-student level but increased error variance by 23% at the between-student level for introjected regulation. Singer and Willet (2003) discuss how that can happen with MLM under certain conditions. For example, this could be a problem when the variance is almost exclusively either between- or within-person and the predictors introduce variability at the level that did not contain as much variability initially. Therefore, pseudo R^2 values should be viewed with caution.

Within-student changes in perceptions of competence and teacher support negatively predicted within-student changes in external regulation ($\gamma = -0.11$, $\gamma = -0.10$, respectively, $ps < .01$). These findings suggest that decreases in perceptions of competence and teacher support associate with increases in external regulation. There were no significant between-student differences or linear change by psychological need interactions predicting external regulation. The R_1^2 and R_2^2 values indicate that compared with the unconditional models, the predictor variables reduced the error variance by 6% at the within-student level and 15% at the between-student levels for external regulation.

Discussion

This study examined physical education motivation regulations across a 2-year period that represented the transition into and across middle school. Changes in motivation during this time are important to understand because the aims of physical education are to provide a foundation for healthy physical activity attitudes, perceptions, and behavior both within and outside of the school context (National Association for Sport & Physical Education, 2004). Results of this study reflect normative decreases in both autonomous forms of motivation and an increase in external regulation during this period. Normative decreases were also found for perceived competence, relatedness, mastery climate, and teacher support. These findings provide an initial description of changes in physical education motivation regulations and social contextual variables in a U.S. sample of students transitioning into and across middle school, contributing to a limited literature on the development of physical education motivation (Barkoukis et al., 2010; Ntoumanis et al., 2009). However, there was significant between-student variability indicating individual differences in initial levels of all motivation-related variables as well as how these variables change over time (with the exception of perceived autonomy). Such variability allowed for the prediction of both initial status and change over time.

Decreases in autonomous forms of motivation and an increase in external regulation as students move into and across the middle school years supported hypotheses, cross-sectional research (Xiang, McBride, Guan, & Solmon, 2003; Digelidis & Papaioannou, 1999) and longitudinal research on developmental trajectories of individual motivation regulations in a British junior high school physical education setting (Ntoumanis et al., 2009). These findings also extend existing longitudinal research on physical education motivation by identifying a shift to more controlling and less autonomous forms of motivation as early as the initial transition into middle school, a period of development not previously examined. This pattern of shifting motivation regulations has important implications as it may help explain declines in physical activity at this period of development (Wall et al., 2011), which could have potential long-term health and well-being implications (Hagger et al., 2009; Power et al., 2011; Standage et al., 2012).

Contrary to hypotheses, the fifth grade students who were entering middle school in the sixth grade did not exhibit greater rates of motivational change compared to those students who moved across the middle school years (i.e., sixth to eighth grade). The rates of change ap-

pear similar during and after the transition to middle school because cohort was a nonsignificant predictor of change over time. Future research that includes more data collection points and a larger sample at each time point is needed to test for nonlinear change or to use a more advanced analytic technique such as sequential cohort analysis, which may uncover cohort differences not identified in this study. Though not dependent on cohort, rates of decline in intrinsic motivation and identified regulation were greater for those students who started with lower levels of these variables. Therefore, the transition to middle school itself may represent less of a threat to students' motivational experiences in physical education for students who have a higher foundation of autonomous motivation. Identifying motivationally vulnerable students during this transition time may be more valuable than viewing the transition itself as posing an equal risk to students.

The implications of the normative changes in motivation should be tempered somewhat by the significant amount of variability found between students both in their initial level of different motivation regulations and in the degree of motivational change they experienced. This suggests that the normative pattern does not represent a universal shift to less adaptive forms of motivation in physical education during early adolescence. All four motivation regulations demonstrated between-student variability in trajectories of change over the 2 years of the study. This variability represents unique pathways that students take as they negotiate the transition to middle school physical education. Results suggest these pathways depend, in part, on the social climate and satisfaction of the needs for competence and relatedness.

The theoretical predictors of between-student variability in motivation regulation change included satisfaction of the needs for competence, autonomy, and relatedness, and mastery climate and teacher support. Conditional models produced effect sizes that ranged considerably (up to 60%), but on average reduced error variance by 21% at the within-person level and 27% at the between-person level, suggesting a sizable proportion of variance accounted for by predictors in most outcomes. Supporting hypotheses, increases in perceived competence and relatedness predicted increases in autonomous forms of motivation, and increases in perceived competence predicted decreases in external regulation. Additionally, as expected, increases in mastery climate and teacher support predicted increases in autonomous motivation and increases in teacher support predicted decreases in external regulation. The presence of these relationships with the inclusion of both social climate perceptions and need satisfaction variables provide further evidence of direct relationships of social climate variables to motivation (e.g., Wilson et al., 2012). Interestingly, these findings run counter to Ntoumanis et al. (2009) who did not find within-student change in social context variables to predict within-student change in motivation variables in a junior high school sample. More research is needed to identify possible factors that may moderate these relationships such as social or cognitive maturity.

According to SDT, psychological need satisfaction is considered a dynamic process which is highly sensitive to context (Deci & Ryan, 2002). Therefore, we considered how specific changes in perceptions of the social context were linked with changes in psychological needs. We found that decreases in teacher support and mastery climate predicted decreases in perceived competence (teacher support only) and relatedness, with meaningful effect sizes (30%–60%). As expected, and in support of cross-sectional research findings, adaptive social climate variables, such as mastery climate and teacher support, are important predictors of basic psychological needs (Cox et al., 2009; Ntoumanis, 2001; Standage et al., 2003). The findings suggest that overall positive social climate and psychological needs decrease over this transition period, therefore, consistent with theoretical expectations, the normative trend was decreased autonomous motivation and increased controlling motivation.

Although most findings are consistent with SDT, the positive associations of perceptions of relatedness and mastery climate to introjected regulation diverge from theoretical expectations. Specifically, increases in perceived relatedness, teacher support and mastery climate predicted increases in introjected regulation, akin to the findings for autonomous motivation. Although introjected regulation is a controlling form of motivation, it can play an adaptive role in exercise and physical activity (Gillison, Osborn, Standage, & Skevington, 2009; Sabiston

et al., 2010; Thogersen-Ntoumani & Ntoumanis, 2006). This adaptive function is likely present in this sample where relatedness and mastery climate perceptions are positively associated with introjected regulation. Increasing cognitive maturity and self-regulation, combined with heightened physical, social, and emotional awareness at this developmental period (Keating, 2004) could explain increased internal pressures of guilt, shame, and pride reflected in introjected regulation when students are in the presence of a supportive social climate. More research is necessary to corroborate introjected regulation speculations.

When predictors were entered in the model, introjected regulation appeared to increase over time. The interaction between gender and change over time provides a tentative suggestion that females may be experiencing decreases while males are experiencing increases in introjected regulation. However, this interaction should be viewed cautiously because although the female simple slope was in the negative direction and the male simple slope was in the positive direction, neither simple slope was significant. The variance actually increased at the between-student level, suggesting that *additional* variance entered into the model, and therefore these findings should be interpreted with much caution (Singer & Willet, 2003).

Perceived autonomy was not associated with either initial level or change in motivation regulations over time. Although this finding is contrary to SDT expectations, the functional significance of each need is sensitive to the context and therefore is likely to vary across contexts (Deci & Ryan, 2000) and development. The compulsory nature of physical education may render autonomy less relevant for motivation within this setting. On the other hand, competence and relatedness may be especially sensitive to this context at this developmental transition and therefore more relevant to change. It should be noted that autonomy also did not demonstrate significant normative change or significant variability in change over time. Future work may consider the nuances of development, context, and need satisfaction to better articulate how perceptions of autonomy change over time. Additionally, the inconclusive interactions between perceived autonomy and linear change predicting autonomous forms of motivation suggest that careful attention to this psychological need is warranted to better understand the role of perceived autonomy in predicting changes in motivation regulations.

Overall, predictors reduced variance by a sizable amount. However, there was remaining variability to be explained suggesting that there are additional factors to explain unique pathways that students may take during this period. One interesting approach to take in the future is to use growth-mixture modeling to examine latent categorical and continuous subpopulations, which may represent different patterns of change (see Muthén, 2001; Nagin, 1999). It would be valuable to examine, for example, distinct subpopulations based on different patterns of motivational characteristics to examine different growth patterns over time. This type of analysis reflects a person-centered approach, (e.g., cluster analysis; latent class analysis) that focuses on relationships among subsets of individuals rather than among variables (i.e., variable-centered approach).

Although this study addresses a gap in the literature on physical education motivation in the transition to middle school, there are several study limitations to note. First, the conclusions should be viewed relative to the sample, representing one region of the United States with an overrepresentation of White students. A more diverse sample, representative of a range of geographic regions, socioeconomic status, population density, culture, and curricula would allow for more generalizable conclusions. Although existing measures with good evidence for reliability and validity were used, future use of state-of-the-art measurement that is developmentally sound is important for future research. Particular caution is noted with the limited validity evidence for the teacher support and relatedness measures. Three waves of data over a 2-year period were used; however, more waves of data would allow for a better test of nonlinear change and to consider more complex growth trajectories. Because MLM assumes time-specific residuals are equal across time, future studies using latent growth modeling may provide additional insight owing to the ability to examine the effect of this equality constraint. Given the interest in how physical education experiences translate to other contexts, future research is advised to link changes in physical education motivation to changes outside the context during this developmental transition. In

particular, it would be valuable to have objective measures of physical activity behavior within and outside of physical education. There was variability yet to be explained in identified and external regulations, suggesting other aspects of the social context and individual differences serve as explanatory mechanisms of change during this period.

Several practical implications emerge from this study. We recommend that careful attention is given to the social contextual changes occurring across the transition into middle school that may impact autonomous motivation. We found changes in perceived competence, relatedness, mastery climate, and teacher support to be salient and teachers may carefully consider how to foster student belonging, cooperation, and competence both before and after the transition to middle school. Increases in external regulation and the decreases in mastery climate that we identified, along with increases in competitive and ego-involving climates found in previous studies (Barkoukis et al., 2010; Ntoumanis et al., 2009), suggest classroom practices could align more closely with cooperative and task-involving climates to foster adaptive motivation patterns. This may be particularly important for those with lower perceptions of psychological needs and autonomous motivation.

This study found that changes in motivation regulations occurred across the transition to middle school. Normative findings suggest an overall pattern of declining autonomous motivation and increasing external regulation but with considerable variability in individual trajectories of change. The inclusion of psychological needs and social contextual perceptions to explain variability in initial levels and change in motivation regulations provided a theoretical examination of factors that are important to the changes exhibited in this transition process. The findings suggest that fostering perceptions of competence, relatedness, mastery climate, and teacher support can all serve to support adaptive changes in motivation regulations, while buffering against the trend toward less adaptive motivation-related experiences. Future work considering other predictors of change, as well as nonlinear trajectories will further advance our understanding of physical education motivation change into and through middle school.

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