EFFECT OF SELF-DETERMINED MOTIVATION IN PHYSICAL EDUCATION ON OBJECTIVELY MEASURED HABITUAL PHYSICAL ACTIVITY: A TRANS-CONTEXTUAL MODEL

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Abstract:

Grounded in the trans-contextual model, the purpose of the present study was to examine the role of self-determined motivation in Physical Education (PE) on self-determined motivation in Physical Activity (PA), PA intention, and accelerometer-measured habitual PA behavior among high-school aged adolescents. A sample of 394 Spanish high-school students (211 males and 183 females; aged 12-16 years) participated in the present study. The outcome measurement of PA was established using accelerometry, whereas motivation toward PA and PE as well as PA intention were measured using validated questionnaires. Path analyses supported in part the central propositions of the trans-contextual model. Self-determined motivation in PE predicted the self-determined motivation in PA (β=.45, $p<.001$, R^2=.26). Self-determined motivation in PA predicted PA intention (β=.51, $p<.001$, R^2=.41). The predictive strength from PA intention to behavior was weak (β=.11, p=.011, R^2=.21) with a statistically non-significant mediational model from self-determined motivation in PA via PA intention to PA behavior (β=.28, p=.231). This weak-to-non-significant relationship does not fully support previous findings that have shown feasibility of the trans-contextual model in charting the pathways from self-determined motivation in an educational context to behaviors in an out-of-school context.

Key words: *autonomy, accelerometry, moderate-to-vigorous physical activity, secondary school students*

Introduction

The World Health Organization has identified physical inactivity as an important correlate of global mortality (WHO, 2013), and physical inactivity has been found to be associated with an increased risk of multiple chronic diseases including cardiovascular diseases (Li & Siegrist, 2012), heart failures (Pandey, et al., 2015), type 2 diabetes mellitus (Sigal, Kenny, Wasserman, Castaneda-Sceppa, & White, 2006), and cancers (Sun, Shi, Gao, & Xu, 2012). Despite the well-documented benefits of regular physical activity (PA), motivation to participate in PA (Gavin, Keough, Abravanel, Moudrakovski, & Mcbrearty, 2014) and actual PA participation decline across lifespan in industrial countries such as the United States (Friedman, et al., 2008) and Spain (Cocca, Liukkonen, Mayorga-Vega, & Viciana, 2014). Research has shown people to be physically most active during childhood with declines in PA participation occurring during adolescence (Cocca, et al., 2014).

Useful means, available to schools, to increase students' PA include offering students such physical education (PE) that: provides daily school recess in playgrounds modified to promote active play, promotes PA in classrooms, and integrates afterschool PA programs (Bassett, et al., 2013). One of the most effective tools to foster children's lifelong PA is a standard school PE curriculum. PE with such characteristics ensures that all students are physically active during school days. In addition, if teachers can provide instruction in PE lessons that foster students' motivation toward PA, it may lead to increased motivation toward and actual participation in PA outside of school (Hagger & Chatzisarantis, 2016).

The trans-contextual model was developed to conceptualize the transfer of self-determined motivation from educational contexts to out-of-school contexts and related behaviors through the belief-based, social cognitive antecedents of behavior (Hagger & Chatzisarantis, 2012). For instance, the model can be useful for researchers and practitioners in their efforts to understand and facilitate children's and adolescents' PA behavior. The trans-contextual model incorporates hypotheses from three prominent psychological pillars: the self-determination theory (Deci & Ryan, 1985), the theory of planned behavior (Ajzen, 1985), and the hierarchical model of intrinsic and extrinsic motivation (Vallerand, Fortier, & Gaya, 1997) to explain the mechanisms by which support for motivation in school PE affects students' involvement in PA behaviors (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Mediation models are fundamental for comprehending the relations between theoretical constructs (e.g., motivation) and behaviour. Although intention to be physically active has been linked to behavior, unfortunately, in literature, as showed in the review made by Rhodes and de Brujin (2013), the so-called intention-behavior discordance or "intention-behavior gap" had shown that there was no clear connection between intention and PA behavior. Therefore, it is recommended to develop studies that incorporate the analysis of possible mediational effects and the relationship between motivation, intention, and behavior (McEachan, Conner, Taylor, & Lawton, 2011; Rhodes & Yao, 2015).

Based on hypotheses from the component theories, the trans-contextual model comprises three central propositions that form a series of empirically-testable hypotheses (Hagger & Chatzisarantis, 2016). Proposition 1 is drawn from the self-determination theory (Deci & Ryan, 1985, 2000) with the hypothesis that perceived support for self-determined motivation from social agents (e.g., teachers) toward school-based activity (e.g., PE in school) will predict self-determined motivation toward similar activities (e.g., physical activities) within the educational context. Proposition 2 relies on the central tenet of the Vallerand's et al. (1997) hierarchical model with the hypothesis that self-determined motivation toward activities in an educational context (e.g., PE) will predict self-determined motivation toward similar activities in an out-of-school context (e.g., PA). And proposition 3 claims that self-determined motivation toward activities (out-of-school context) predicts future intention to engage in the activities as well as actual behavioral engagement.

The central propositions of the trans-contextual model have received empirical support across multiple studies, particularly those conducted in PE and leisure-time (out-of-school) contexts and in studies focusing on habitual PA (for a review and meta-analysis see Hagger & Chatzisarantis, 2016). Previous studies have found significant relationships between perceived autonomy support and self-determined motivation in PE (Proposition 1; e.g., Hagger, et al., 2009, 2003; Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005), between self-determined motivation in PE and PA (Proposition 2; e.g., Barkoukis, Hagger, & Lambropoulos, Torbatzoudis, 2010; Hagger, et al., 2003, 2005), between self-determined motivation and intention toward PA (Proposition 3; Barkoukis, et al., 2010; Hagger, et al., 2003, 2005, 2009), and between PA intention and PA engagement (Proposition 3; Barkoukis, et al., 2010; Hagger, et al., 2003, 2005, 2009).

Although previous research has shown trans-contextual model to be a useful framework to understand the role of self-determined motivation in PE in fostering PA, there is a lack of trans-contextual model-based studies examining PA participation using objectively measured behavioral outcomes. Previous research has relied too heavily on self-reported measures of behavior, particularly self-reported PA, which, although correlated with objective measurements, have inherent problems in terms of recall and respondent bias, limitations that have been acknowledged previously (Hagger & Chatzisarantis, 2016). Thus far, Hagger and co-workers have found support for the model predicting an objectively measured index of out-of-school engagement in activities with indirect effects of perceived autonomy support from teachers and self-determined motivation in the school context (Hagger, Sultan, Hardcastle, & Chatzisarantis, 2015). However, these studies examined engagement in mathematics homework activities and measured studies homework grades as an objectively measured index of engagement in out-of-school activities. In addition, it is highly important to determine the impact of self-determined motivational experiences on students' motivation to be physically more active in and out-of-school. To date, no study has tested effects of the trans-contextual model in the context of PE in school and participation in PA using an objective measurement of PA behavior. The study of Standage, Gillison, Ntoumanis, and Treasure (2012) is the only one that addressed this topic of study with objectively measured PA. However, in their study PA was measured by pedometers and the intention to be physically active was not taken into account in the path analysis, just the basic psychological needs and the physical self-concept.

Thus, the purpose of the present study was to examine the effect of self-determined motivation in PE on habitual PA behavior (via the intention to be physically active) using objectively measured PA through accelerometers. The following main hypotheses were tested (Figure 1): H1) Self-determined motivation in PE (educational context) will predict self-determined motivation in PA contexts;

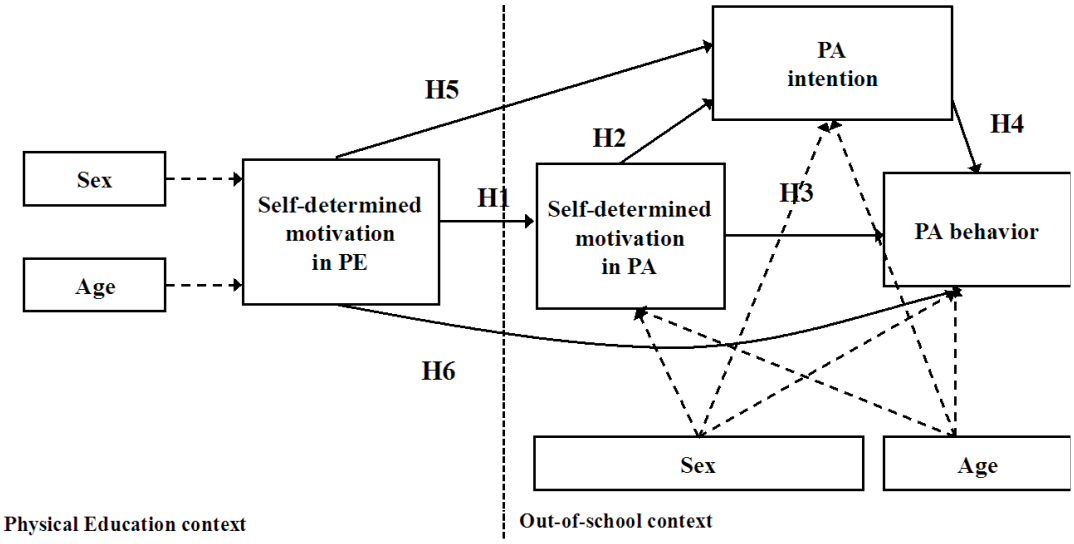

Figure 1. A schematic diagram of the hypothesized relationships. Solid arrows represent the hypothesized relationships, whereas the dashed represent the covariates. All hypothesized effects are expected to be positive.

H2) Self-determined motivation in PA will predict PA intention; H3) Self-determined motivation in PA will predict habitual PA behavior; H4) PA intention will predict habitual PA behavior; H5) Self-determined motivation in PE will predict PA intention; and H6) Self-determined motivation in PE will predict habitual PA behavior. In addition, the following two supplementary hypotheses were tested to examine indirect effects focusing on the mediating roles of self-determined motivation and intention toward out-of-school PA: H7) Self-determined motivation in PE predicts PA intention via self-determined motivation in PA; and H8) Self-determined motivation in PA will predict habitual PA behavior via PA intention.

Methods

Participants

A sample of 394 (211 males and 183 females) Spanish high-school students (age=13.92±1.12 years; body mass index=21.51±3.65 kg/m^2) participated in the present study. All the students and their legal guardians were fully informed about the features of the present study. Students' assents and their legal guardians' written informed consents were obtained. The protocol of the present study was approved by the Ethical Committee of the University of Granada.

Measures

Self-determined motivation in PE. Self-determined motivation in PE was measured using the Spanish version of the Perceived Locus of Causality (PLOC) scale in PE (Moreno, González-Cutre, & Chillón, 2009). This questionnaire consisted of a 20-item scale with five four-item subscales measuring intrinsic motivation, three forms of regulation for extrinsic motivation (identified, introjected, and external), and amotivation. Participants were presented with a common stem: "*I participate in PE class...*", followed by the items reflecting different types of motivation. Responses to each item were made on five-point Likert-type scales ranging between *1=totally disagree* to *5=totally agree*. The Spanish version of the PLOC scale has adequate psychometric properties (α values between .61 and .76; CFI = .90, IFI = .90, TLI .87, RMSEA = .06, SRMR = .07) (Moreno, et al., 2009). A self-determined index (SDI) was calculated by weighing the scores of each subscale and aggregating them to derive a single score (Vallerand, et al., 1997). A more positive index indicates a greater self-determined motivation in PE.

Self-determined motivation in physical activity. Self-determined motivation in PA was measured using the Spanish version of the Behavioral Regulation in Exercise Questionnaire (BREQ-3) (González-Cutre, Sicilia, & Fernández, 2010). This instrument assessed students' underlying decisions to engage or not engage in physical activities outside PE contexts. This questionnaire consisted of a 23-item scale with six subscales that measured intrinsic motivation, integrated motivation, four forms of regulation for extrinsic motivation (integrated, identified, introjected, and external), and amotivation. For each dimension four items (except for identified regulation, which had three) were rated on a 5-point Likert-type scale (*1=absolutely untrue … 5=absolutely true*). The stem was "*I do physical exercise...*", and items represented possible motives to that question, reflecting different types of motivation. The Spanish version of the BREQ-3 had adequate psychometric properties (α values between .66 and .87; CFI = .91, IFI = .91, RMSEA = .06, SRMR = .06) (González-Cutre, et al., 2010). The SDI index was also calculated from

the dimensions of this questionnaire using the standard formula (Vallerand, et al., 1997).

Physical activity intention. The intention to be physically active outside of school PE was measured by the Spanish version of the intention to be physically active questionnaire (Moreno, Moreno, & Cervelló, 2007). This questionnaire consisted of a 5-item scale. Participants responded to the items on a five-point Likert-type scale (*1=totally disagree … 5=totally agree*). The questionnaire has demonstrated adequate psychometric properties (α = .94; CFI = .98, TLI = .96, RMSEA = .056, SRMR = .018; Moreno, et al., 2007).

Physical activity behavior. An objective measurement of habitual moderate-to-vigorous PA behavior was obtained using a GT3X+ accelerometer (ActiGraph, LLC, Pensacola, FL, USA). This accelerometer is a compact, small (4.6 x 3.3 x 1.5 cm), lightweight (19 g), and triaxial monitor designed to record time of varying accelerations. Adolescents were requested to wear the accelerometer for seven consecutive days. At least three days of recording (two weekdays and one weekend day), with a minimum of 600 min registration per day (60 min of consecutive zero-count *epochs* were defined as a non-wear period) was set as an inclusion criterion. Since children's PA patterns are characterized by short bursts of rapidly changing activity, in the present study the interval of time (*epoch*) was set at 1 s (Calahorro, et al., 2015). To determine the time (minutes) engaged in moderate-to-vigorous PA, Evenson's cut-off points were used (Trost, Loprinzi, Moore, & Pfeiffer, 2011). The habitual moderate-to-vigorous PA behavior was calculated as: [(5×weekdays)+(2×weekend days)]/7. The data were downloaded and analyzed by the *ActiLife Lifestyle Monitoring System Software* version 6.9.2. Accelerometer-measured PA has been shown to be valid in adolescents (ROC-AUC = .90; sensitivity = .88, specificity = .92; Trost, et al., 2011).

Procedures

The school head and the PE teacher of a high school were requested to participate in the present study. They were provided with full details of the study and were asked to provide written consent for the study to be conducted in the school. The school provided consent to participate in advance of data collection. Next, all the students and their parents or legal guardians were contacted and asked to participate in the study. They were fully informed of study requirements, expectations, and participants' rights. Students' assents and their legal guardians' written informed participation consents were obtained prior to data collection.

The confidentiality of the PA data and the rules for wearing accelerometers were explained to the participants prior to data collection. The participants were requested to wear the accelerometer for seven consecutive days positioned on the right hip by an elastic belt. The participants were asked to wear the accelerometer for the whole day from waking to bedtime and to take it off only when engaged in aquatic activities or taking a shower. Two trained researchers fitted the accelerometers to all the participants. Students who were participating in organized sports activities were encouraged to continue with them and were urged to maintain their normal levels of daily PA. A week later, questionnaires were administered to students in two PE classes. The researcher explained how to complete the three questionnaires and provided an example of how to respond to items at the beginning of each session.

Statistical analyses

Normality of the data was examined using skewness and kurtosis values which should range from -2 to +2. Internal consistency of the psychometric scales was assessed using Cronbach's alpha. Descriptive statistics of the variables were reported using aggregated means, standard deviations (SD), and Pearson's correlation coefficients. From the initial sample of 394 participants, 165 students had some missing data. Missing data were assumed to be randomly missing (Collins, Schafer, & Kam, 2001). Next, a path analysis strategy was conducted to test the hypotheses (Mulaik & Millsap, 2000). A path model is a multivariate regression model that describes the relationship between a set of observed variables. Based on the trans-contextual model, covariance stabilities in regard of *a priori* default model (Figure 1) were estimated as follows: self-determined motivation in PE→ self-determined motivation in PA→ PA intention→ PA behavior. Additional paths from self-determined motivation in PE to PA intention and self-determined motivation in PA to PA behavior were also added. In addition, sex and age were added as covariates by establishing direct paths to all research variables.

All analyses were performed using the Mplus statistical package (Version 7.1; Muthén & Muthén, 2015). A COMPLEX option was used to correct a possible non-independence of the observations based on students being nested within their PE classes (Asparouhov, 2005). A structural equation model (SEM) fits the data well when the p value associated with the chi-square test is non-significant. Additionally, if the values of the Bentler comparative fit index (CFI) and Tucker-Lewis index (TLI) are above .95 and the values of the Root Mean Squared Error of Approximation (RMSEA) are below .06, a good fit between the hypothesized model and the observed data exists (Hu & Bentler, 1999). Indirect effect was computed using bootstrapping (5,000 bootstrapped samples) procedures with 95% confidence intervals determining the indirect effects at the 2.5th and 97.5th percentiles.

Results

Table 1 presents descriptive statistics. Data were normal skewness and kurtosis values ranging between -.84 to .41 and -.24 to 1.19, respectively. Internal consistency of psychological variables was acceptable, Cronbach's alphas ranging from .61 to .89. Bonferroni-corrected *t*-tests showed that there were no differences between the students with no missing values and the ones with missing values (all paired *t*-values <1.86). This finding corroborates the assumption that values were randomly missed. In addition, the preliminary analyses showed that on average students had a relative high self-determined motivation in PE (M=17.81 [3.52]) and PA (M=16.22 [2.89]). Also, on average, students' PA intention for future PA was high (M=4.02 [.81]) and students were moderately to vigorously physically active on average 57.01 (19.23) minutes per day. The correlational results supported the tenets of the trans-contextual model, indicating that self-determined motivation in PE and PA as well as PA intention had a moderate to strong positive relationship (ranging from .42 to .61). PA behavior had a weak positive relationship to self-determined motivation in PE, self-determined motivation in PA and PA intention (ranging from .13 to .21).

Standardized path coefficients from the path analysis testing the hypothesized model are provided in Figure 2 and Table 2. The demonstrated acceptable fit with the data based on the multiple criteria adopted (χ^2[1]=.295, p=.587; CFI=1.00; TLI=.99; RMSEA=.001, 90% CI RMSEA [.00, .10]). The analyses showed that self-determined motivation in PE predicted self-determined motivation in PA (H1, β=.45, p<.001) and self-determined motivation in PA predicted PA intention (H2, β=.51, p<.001). However, self-determined motivation in PA did not predict PA behavior (H3, β=-.05,

Table 1. Summary of intercorrelations, means (M), standard deviations (SD), and Cronbach's alpha coefficients (α) for all variables

Variables	1	2	3	4	5	6	M	SD	α	Skewness	Kurtosis
1. Self-determined motivation in PE	-						17.81	3.52	.61-.83	-.07	.38
2. Self-determined motivation in PA	.47**	-					16.22	2.89	.66-.89	-.13	1.19
3. PA intention	.42**	.61**	-				4.02	.81	.78	-.84	.50
4. PA behavior	.13*	.21**	.21**	-			57.01	19.23	-	.41	-.24
5. Sex	-.21**	-.26**	-.30**	-.42**	-		-	-	-	-	-
6. Age	-.21**	-.04	-.04	.13	.02	-	13.94	1.12	-	-	-
M	3.68	3.46	3.53	3.17	5.44	5.13					
SD	.81	.61	.64	.57	1.38	1.68					

Note. PE = Physical Education; PA = physical activity.
*p<.05, **p<.001.

Table 2. Standardized path coefficients for path analysis testing trans-contextual model hypotheses

Parameter estimates	Standardized values (β)
Regression coefficients	
Self-determined motivation in PE → Self-determined motivation in PA	.45 (.05)**
Self-determined motivation in PA → PA intention	.51 (.05)**
Self-determined motivation in PA → PA behavior	-.05 (.08)
PA intention → PA behavior	.11 (.04)*
Self-determined motivation in PE → PA intention	.15 (.06)*
Self-determined motivation in PE → PA behavior	.02 (.06)
Covariate regression coefficients	
Sex → Self-determined motivation in PE	-.20 (.05)**
Age → Self-determined motivation in PE	-.20 (.05)**
Sex → Self-determined motivation in PA	-.17 (.05)**
Age → Self-determined motivation in PA	.04 (.05)
Sex → PA intention	-.13 (.04)*
Age → PA intention	.02 (.04)
Sex → PA behavior	-.39 (.06)**
Age → PA behavior	-.22 (.06)**

Note. PE = Physical Education; PA = physical activity.
*p<.05, **p<.001.

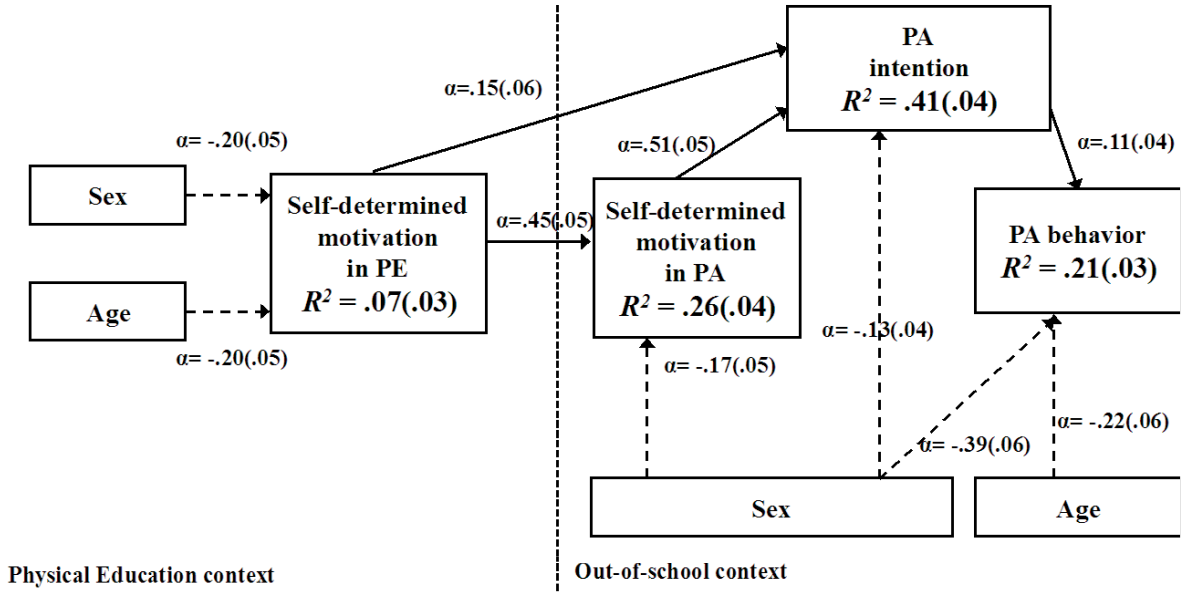

Figure 2. A path model visualization of the found relationships. Solid arrows represent the hypothesized relationships, whereas the dashed represent the covariates.

p=.516) and self-determined motivation in PE did not predict PA behavior (H6, β=.02, p=.812). PA intention predicted PA behavior (H4, β=.11, p=.011) and self-determined motivation in PE predicted PA intention (H5, β=.15, p=.006).

Tests of indirect effects revealed a statistically significant indirect effect of students' self-determined motivation in PE on PA intention through self-determined motivation in PA (H7, β=.06, p<.001, CI 95% [.04, .08]). However, the indirect effect of self-determined motivation in PA on PA behavior through PA intention was not statistically significant (H8, β=.28, p=.231, CI 95% [-.27, .08]).

Of the covariates, sex had statistically significant and negative relationships with PA behavior (β=-.39, p<.001), PA intention (β=-.13, p<.05), self-determined motivation in PA (β =-.17, p<.001), and self-determined motivation in PE (β=-.20, p<.001). The negative relationships indicated that boys had higher values compared to girls. Age was negatively related to PA behavior (β =-.22, p<.001) and self-determined motivation in PE (β =-.20, p<.001), showing that younger students were more physically active and more self-determinedly motivated in PE. The covariates explained a statistically significant and moderate amount of the variance in the dependent variables (PA behavior, R^2=.21 [.05]; PA intention, R^2=.41 [.04]; self-determined motivation in PA, R^2=.26 [.04]; self-determined motivation in PE, R^2=.08 [.03]).

Discussion and conclusions

The purpose of the present study was to examine the effects of self-determined motivation in PE on self-determined motivation in PA, PA intention, and objectively measured habitual PA behavior in Spanish high-school students. Based on the trans-contextual model, the present research proposed that self-determined motivation in PE would predict, through self-determined motivation in PA and PA intention, students' habitual PA behavior in a mediational model. While results corroborated some of the fundamental propositions of the trans-contextual model, such as the transfer of motivation across PE and PA contexts, some important premises were relatively weak, such as the relation between PA intentions and behavior, or not supported, such as the indirect effects of self-determined motivation in PE on PA behavior.

Current findings supported the hypothesis that self-determined motivation in PE predicted self-determined motivation in PA, consistent with previous research on the trans-contextual model (e.g., Barkoukis, et al., 2010; Hagger, et al., 2003, 2005, 2009). The size of this predictive effect was moderate; self-determined motivation in PE explained 26% of the variance of self-determined motivation in PA, supporting the practical meaningfulness of the findings. Vallerand et al. (1997) proposed that there is a positive relationship between forms of self-determined motivation across different contexts. The mechanisms underpinning this transfer are due to experiences of previous behavior in a given context providing a motivational schema, which then serves as a pre-existing template for similar participation behaviors in the different contexts in the future. An alternative explanation derived from the self-determination theory suggests that school students who internalize their PE activities as self-satisfying and satisfy their psychological need for autonomy are more likely to pursue such behaviors in other contexts (Deci & Ryan, 1985, 2000; Hagger & Chatzisarantis, 2016).

The current study showed that self-determined motivation in PA predicted PA intention, which was consistent with the underlying trans-contextual model and previous research (Chatzisarantis & Hagger, 2009; Hagger, et al., 2003, 2009). It was also found an indirect effect of students' self-determined motivation in PE on PA intention via self-determined motivation in PA. These findings support the premise of the trans-contextual model proposing that the future behavior engagement is a function of intentions, a motivational construct reflecting the preplanned plan for behavior. Specifically, it indicates that schoolchildren are likely to align their intentions regarding future participation in PA with their self-determined motives, consistent with the proposition that students who cite self-determined reasons for engaging in PA are more likely to form intentions to do so in the future because the behavior services their psychological need for autonomy. It is important to note that the original theory of planned behavior postulates that intention mediates the effect of attitudes, subjective norms, and perceived behavioral control on behavior. While these belief-based constructs were not measured, the mechanism by which self-determined motivation impacts intentions is likely through these antecedent beliefs.

An important finding of the present study was that students' PA intention positively predicted their habitual moderate-to-vigorous PA levels measured by objective means. This is consistent with the central tenet of the theory of planned behavior and numerous previous findings showing that intention is the most proximal determinant of behaviors (see meta-analysis by McEachan, et al., 2011). However, contrary to the hypotheses, there was no statistically significant direct effect of self-determined motivation in PA on PA behavior and no indirect effect of self-determined motivation in PA on PA behavior mediated by PA intention. While the constituent effects of self-determined motivation in PA on PA intention and PA intention on PA behavior were statistically significant, the effects were not sufficiently strong to result in a large indirect effect to meet conventional levels of statistical significance. In particular, the intention-behavior relationship in the current research was very small, which likely accounted for the weak, non-significant indirect effect. A possible explanation may be the adoption of an objective measurement of PA based on accelerometry rather than self-reports of PA. Previous studies have shown that the effect of forms of motivation from self-determination theory and intentions from the theory of planned behavior on objectively measured PA have been weaker compared to the same effects with self-report measures of PA (Barkoukis, et al., 2010; Hagger, et al., 2003, 2005, 2009). Although correlations between motivational variables and PA behavior were positive and thus supported the theoretical postulations, it is true that the effect of students' self-determination in PE or PA did not have either direct or indirect relationship with PA behavior. These findings indicate that students who are self-determined in PE and PA are also more physically active in and outside of school. On the other hand, our findings also suggest that highly self-determined motivation toward PE and/or PA does not automatically lead to high PA. Previous studies have shown that there are multiple factors/barriers that may interfere with the motivation and behavior relationship (Dishman, Sallis, & Orenstein, 1985; Trost, Kerr, Ward, & Pate, 2001). For instance, middle school-aged adolescents are dependent on their parents and are not able to be physically active independently. In addition, families may have financial or transportation problems that hinder their actual activity, despite their motivation to be active. Finally, it is also a well-demonstrated fact that middle school-aged students have quite a bit of homework that may conflict with being physically active.

These findings raise questions over the adequacy of current motivational and social cognitive theories in accounting for variance in habitual PA behavior. It is clear from the current research that while intentions predicted behavior, the effect was very small and self-determined motivation had a null effect. This has important ramifications. It means that research using these models may have reported effects that were inflated due to methodological variance introduced by the use of self-reported PA. It also means that such models may be inadequate as accounts PA behavior and should be rejected. If the current findings are generalized to the broader population, then current findings would also point to the inadequacy of the current model as a guide for interventions to change behavior. Previous research has suggested that motivational and social cognitive models, like the theory of planned behavior, self-determination theory and the trans-contextual model, may serve as bases for intervention by targeting constructs that are strongly related to behavioral outcomes (e.g., habitual PA behavior). However, the weak effects in the current study suggest that interventions targeting self-determined motivation would practically have no significant effect on PA behavior.

Of course, it would be premature to dismiss the models in the current research given the meta-analytic evidence supporting the constituent theories of the trans-contextual model, namely the theory of planned behavior (McEachan, et al., 2011), the self-determination theory (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003), and the trans-contextual model itself (Hagger & Chatzisarantis, 2016). Nevertheless, there is recognition that a preponderance of studies contributing to these analyses adopts self-reported beha-

viors, which may inflate relations of motivational and social cognitive constructs with behavior. The current research should therefore provide important evidence to suggest that the effects of current theories and models should not be considered immutable or axiomatic. Rather, current findings should inspire further research that would these theories in PA contexts by adopting robust, objective measurements of behavior, such as those adopted in the current study. Such findings will begin to build converging evidence for the true effects of hypothesized relations in these models and whether they are adequate in explaining behavior.

The main strength of the present study was accelerometer-measured PA. Objective PA assessment improves validity of PA measurement compared to self-reported measurements (Shephard, 2003). A limitation of this study was a cross-sectional sample that limits any suggestions of causality between research variables and the poor internal consistency in the introjected regulation measures. In addition, a further limitation is the use of a convenience sample, which limits the generalization of the findings.

In conclusion, the findings of this study supported partly the central tenets of the model, showing that: (a) self-determined motivation in PE will transfer into self-determined motivation in PA and (b) self-determined motivation in PA will predict high-school students' preplanned PA intention. The evidence for the PA intention – objectively measured PA behavior was weak, not supporting previous findings and questioning the practical utility of the trans-contextual model in health promotion efforts. Future studies utilizing the objective measurements of PA behavior are needed to examine whether these findings are due to actual disparities in the trans-contextual model, or whether the results are contributed to the differences in the methodology between the self-reported and accelerometer-measured habitual PA.

References

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg: Springer.

Asparouhov, T. (2005). Sampling weights in latent variable modeling. *Structural Equation Modeling*, *12*, 411-434.

Barkoukis, V., Hagger, M.S., Lambropoulos, G., & Torbatzoudis, H. (2010). Extending the trans-contextual model in physical education and leisure-time contexts: Examining the role of basic psychological need satisfaction. *British Journal of Educational Psychology*, *80*, 647-670.

Bassett, D.R., Fitzhugh, E.C., Heath, G.W., Erwin, P.C., Frederick, G.M., Wolff, D.L., …, & Stout, A.B. (2013). Estimated energy expenditures for school-based policies and active living. *American Journal of Preventive Medicine*, *44*, 108-113.

Calahorro, F., Torres-Luque, G., López-Fernández, I., Santos-Lozano, A., Garatachea, N., & Álvarez, E. (2015). Actividad física y acelerometría; orientaciones metodológicas, recomendaciones y patrones. [Physical activity and accelerometry; methodological orientations, recommendations, and patterns. In Spanish.] *Nutrición Hospitalaria*, *31*, 115-128.

Chatzisarantis, N.L.D., & 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*, 29-48.

Chatzisarantis, N.L.D., Hagger, M.S., Biddle, S.J.H., Smith, B., & Wang, C.K.J. (2003). A meta-analysis of perceived locus of causality in exercise, sport, and physical education contexts. *Journal of Sport and Exercise Psychology*, *25*, 284-306.

Cocca, A., Liukkonen, J., Mayorga-Vega, D., & Viciana, J. (2014). Health-related physical activity levels in Spanish youth and young adults. *Perceptual and Motor Skills*, *118*, -–260.

Collins, L.M., Schafer, J.L., & Kam, C.M. (2001). A comparison of inclusive and restrictive strategies in modern missing data procedures. *Psychological Methods*, *6*, 330-351.

Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.

Deci, E.L., & Ryan, R.M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227-268.

Dishman, R.K., Sallis, J.F., & Orenstein, D.R. (1985). The determinants of physical activity and exercise. *Public Health Reports*, 100(2), 158-171.

Friedman, H.S., Martin, L.R., Tucker, J.S., Criqui, M.H., Kern, M.L., & Reynolds, C.A. (2008). Stability of physical activity across the lifespan. *Journal of Health Psychology*, *13*, 1092-1104.

Gavin, J., Keough, M., Abravanel, M., Moudrakovski, T., & Mcbrearty, M. (2014). Motivations for participation in physical activity across the lifespan. *International Journal of Wellbeing*, *4*, 46-61.

González-Cutre, D., Sicilia, A., & Fernández, A. (2010). Hacia una mayor comprensión de la motivación en el ejercicio físico: Medición de la regulación integrada en el contexto español. [Toward a better comprehension of motivation in physical exercise: Measurement of integrate regulation in the Spanish context. In Spanish.] *Psicothema*, *22*, 841-847.

Hagger, M.S., & Chatzisarantis, N.L.D. (2012). Transferring motivation from educational to extramural contexts: A review of the trans-contextual model. *European Journal of Psychology Education*, *27*, 195-212.

Hagger, M.S., & Chatzisarantis, N.L.D. (2016). The trans-contextual model of autonomous motivation in education: Conceptual and empirical issues and meta-analysis. *Review of Educational Research*, *86*, 360-407.

Hagger, M.S., Chatzisarantis, N.L.D., Barkoukis, V., Wang, C.K.J., & 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*, 376-390.

Hagger, M.S., Chatzisarantis, N.L., Culverhouse, T., & Biddle, S.J.H. (2003). The process by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behavior: A trans-contextual model. *Journal of Educational Psychology*, *95*, 784-795.

Hagger, M.S., Chatzisarantis, N.L.D., Hein, V., Pihu, M., Soós, I., Karsai, I., …, & Leemans, S. (2009). Teacher, peer, and parent autonomy support in physical education and leisure-time physical activity: A trans-contextual model of motivation in four cultures. *Psychology and Health*, *24*, 689-711.

Hagger, M.S., Sultan, S., Hardcastle, S.J., & Chatzisarantis, N.L. (2015). Perceived autonomy support and autonomous motivation toward mathematics activities in educational and out-of-school contexts is related to mathematics homework behavior and attainment. *Contemporary Educational Psychology*, *41*, 111-123.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1-55.

Li, J., & Siegrist, J. (2012). Physical activity and risk of cardiovascular disease – A meta-analysis of prospective cohort studies. *International Journal of Environmental Research and Public Health*, *9*, 391-407.

McEachan, R.R.C., Conner, M.T., Taylor, N., & Lawton, R.J. (2011). Prospective prediction of health-related behaviors with the Theory of Planned Behavior: A meta-analysis. *Health Psychology Review*, *5*, 97-144.

Moreno, J.A., González-Cutre, D., & Chillón, M. (2009). Preliminary validation in Spanish of a scale designed to measure motivation in physical education classes: The Perceived Locus of Causality (PLOC) Scale. *Spanish Journal of Psychology*, *12*, 327-337.

Moreno, J.A., Moreno, R., & Cervelló, E. (2007). El autoconcepto físico como predictor de la intención de ser físicamente activo. [The physical self-concept as a predictor of intention to be physically active. In Spanish.] *Psicología y Salud*, *17*, 261-267.

Mulaik, A., & Millsap, R.E. (2000). Doing the four-step right. *Structural Equation Modeling*, *7*, 36-73.

Muthén, L.K., & Muthén, B.O. (2015). *Mplus user's guide* (7th ed.). Los Angeles: Authors.

Pandey, A., Garg, S., Khunger, M., Darden, D., Ayers, C., Kumbhani, D., …, & Berry, J.D. (2015). Dose response relationship between physical activity and risk of heart failure: A meta-analysis. *Circulation*, *132*, 1786-1794.

Rhodes, R.E., & de Brujin, G.J. (2013). How big is the physical activity intention-behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology, 18*(2), 296-309.

Rhodes, R.E., & Yao, C.A., (2015). Models accounting for intention-behavior discordance in the physical activity domain: A user's guide, content overview, and review of current evidence. *Nutrition and Physical Activity, 12*, 9.

Shephard, R.J. (2003). Limits to the measurement of habitual physical activity by questionnaires. *British Journal of Sports Medicine*, *37*(3), 197-206.

Sigal, R.J., Kenny, G.P., Wasserman, D.H., Castaneda-Sceppa, C., & White, R.D. (2006). Physical activity/exercise and type 2 diabetes: A consensus statement from the American Diabetes Association. *Diabetes Care*, *29*, 1433-1438.

Standage, M., Gillison, F.B., Ntoumanis, N., & Treasure, D.C. (2012). Predicting students' physical activity health-related well-being: A prospective cross-domain investigation of motivation across school physical education and exercise settings. *Journal of Sport and Exercise Psychology, 34*, 37-60.

Sun, J.Y., Shi, L., Gao, X.D., & Xu, S.F. (2012). Physical activity and risk of lung cancer: A meta-analysis of prospective cohort studies. *Asian Pacific Journal of Cancer Prevention*, *13*, 3143-3147.

Trost, S.G., Kerr, L.M.,Ward, D.S., & Pate, R.R. (2001). Physical activity and determinants of physical activity in obese and non-obese children. *International Journal of Obesity, 25,* 822-829.

Trost, S.G., Loprinzi, P.D., Moore, R., & Pfeiffer, K.A. (2011). Comparison of accelerometer cut points for predicting activity intensity in youth. *Medicine and Science in Sports and Exercise*, *43*(7), 1360-1368.

Vallerand, R.J., Fortier, M.S., & Gaya, F. (1997). Self-determination and persistence in a real-life setting: Toward a motivational model of high school dropout. *Personality and Social Psychology*, *72*, 1161-1176.

World Health Organization (WHO). (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. Switzerland: WHO.

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