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Running head: PHYSICAL ACTIVITY THEORY TEST

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Testing Social Cognitive Theory to Explain Physical Activity among Adolescent Girls

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from Low-income Communities

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Abstract

Purpose: The aim of this study was to test the hypothesized structural paths in Bandura's Social Cognitive Theory (SCT) model to adolescent girls' physical activity following a 12-month physical activity and dietary intervention to prevent obesity.

Methods: We conducted a 12-month follow-up study of 235 adolescent girls (13.2 years, SD=0.4) from 12 secondary schools located in low-income communities. At baseline, participants completed SCT scales related to physical activity (i.e., self-efficacy, intention, parental support, and outcome expectations). At baseline and 12-months (post-intervention), participants wore accelerometers for seven days.

Structural equation modeling was used to determine if T1 measures predicted physical activity at 12-month after adjusting for baseline activity. **Results:** The model explained 28% and 34% of the variance in physical activity and intention, respectively. Model fit indices indicated the data were a good fit to the model, however only self-efficacy was associated with physical activity at 12-months. There was no support for intention or outcomes expectations as proximal determinants of behavior. Self-efficacy was associated with outcome expectations and parental support, however only outcome expectations predicted intention. **Conclusions:** Current findings indicate a large proportion of the variance for physical activity and intention remains unexplained, and that the proposed pathways in the SCT model were not fully supported. Future model testing may need to consider augmentation or integration of theoretical models which may include ecological components if we are to advance our understanding of physical activity behavior in this sub-group of the adolescent population.

Key words: Self-efficacy, accelerometer, health behavior

1   Testing Social Cognitive Theory to Explain Physical Activity Change among
2   Adolescent Girls from Low-income Communities

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4   Despite the extensive health benefits and protective effects of engaging in
5 regular physical activity (Warburton, Nicol, & Bredin, 2007), participation levels
6 among many adolescents remain inadequate with a large proportion failing to achieve
7 the recommended 60 minutes of daily moderate-to-vigorous physical activity
8 (MVPA) (U.S. Department of Health & Human Services, 2008). Furthermore,
9 physical activity participation rates decline during adolescence, and there is evidence
10 to suggest that this decline is more pronounced in adolescent girls and among those of
11 low socioeconomic position (SEP) (Brodersen, Steptoe, Boniface, & Wardle, 2007;
12 Nader, Bradley, Houts, McRitchie, & O'Brien, 2008). Consequently establishing
13 successful interventions that improve physical activity behavior in high-priority
14 adolescent groups is needed, and an important part of this process is improving our
15 understanding of what drives physical activity behaviors in these groups. As such,
16 researchers have been prompted to adopt models of social cognition to help identify
17 what role various psychological and social factors may have in influencing physical
18 activity behavior in young people (Hagger, 2009).

19   Social cognitive theories [e.g., SCT, Theory of Planned Behavior (TPB),
20 Health Promotion Model (HPM)] typically propose a framework or model that
21 specifies relationships among psychological and social factors within a scheme that is
22 hypothesized to determine a health behavior. Testing theoretical models extends our
23 understanding of health behavior by examining how proposed factors may interrelate
24 to predict or explain patterns of behavior. This research is important because the

1 findings can help to support or refute a theory's utility in guiding effective
2 theoretically-based interventions.

3   Prominent among models of social cognition is Bandura's (1986) SCT which
4 provides a framework for explaining why people acquire and maintain healthful
5 behaviors. According to Bandura (1986), human behavior is the product of the
6 dynamic interplay of personal, environmental and behavioral factors. This relationship
7 between factors is referred to as 'reciprocal determinism', as each factor may affect or
8 be affected by the others. In Bandura's (2004) more recent commentary of the SCT, a
9 framework is presented which specifies a core set of determinants and the
10 mechanisms through which these determinants are operationalized to influence health-
11 promoting behavior. These determinants include knowledge, self-efficacy, goals,
12 outcome expectations, and perceived facilitators and impediments. What creates the
13 precondition for behavior change is *knowledge* of the health risks and benefits of a
14 particular health-related habit, but additional self-influences are often needed to help
15 people overcome possible inertia to change. Self-efficacy is considered to be the
16 central determinant in SCT because it influences behavior both directly and indirectly
17 through goals, outcome expectations and facilitators/impediments. Self-efficacy refers
18 to an individual's belief in their capacity to exercise control over their behavior (e.g., I
19 can still find the time to be physically active even when I've had a busy day). Personal
20 belief is paramount in personal change because it provides motivation and incentive to
21 overcome barriers to change, and evokes feelings of empowerment to enact change.

22   In SCT, *goals* are hypothesized to be the direct antecedent to behavior and are
23 equivalent to the construct 'intentions' in the Theory of Planned Behavior (Ajzen,
24 1991). Bandura (2004) explains that intentions can be considered proximal goals since
25 *aiming* to perform a particular behavior (e.g., to participate in physical activity on

1 most days of the week) is essentially the same as *intending* to perform a particular
2 behavior. Goals, when highly valued, enhance motivation to adopt healthy behavior
3 practices. While goals can be proximal or distal, it is the short-term goals that are
4 most effective in enacting behavior change. *Outcome expectations* are hypothesized to
5 directly predict behavior and one's goals. Outcome expectations refer to the outcomes
6 people expect their actions to produce which can be physical, social and self-
7 evaluative in nature. In the physical activity context, physical outcomes can
8 encompass the pleasant and negative effects of being physically active and the related
9 losses and gains. Social outcomes involve interpersonal relationships and how
10 significant others may reinforce or discourage future displays of a behavior. Behavior
11 is also regulated by self-evaluative reactions. That is, people continue to behave in
12 ways that give them self-satisfaction and self-worth, and abstain from behaviors that
13 induce feelings of self-dissatisfaction. Finally, *facilitators* and *impediments* to health
14 behavior encompass the perceived social (e.g., family/peer support reinforcing
15 physical activity) and structural (e.g., access to facilities to support physical activity)
16 factors that may encourage or obstruct healthy practices. In the SCT model,
17 facilitators and impediments are hypothesized to determine one's goals in striving for
18 a health behavior. In summary, the relationships between the SCT determinants are
19 operationalized such that individuals with high efficacy beliefs tend to expect more
20 favorable outcomes for their efforts, are more likely to overcome barriers to
21 performing the behavior, and demonstrate stronger commitment to the goals they set
22 themselves. In comparison, individuals with poor efficacy beliefs expect their efforts
23 to result in poor outcomes, and perceive barriers to behavior to be insurmountable and
24 the necessary support to facilitate behavior change to be largely absent, leading to less
25 likelihood of planning for and enacting a behavior.

1   There is an extensive literature reporting a range of social cognitive influences
2 of physical activity behavior in children and adolescents. For example, there is
3 consistent support for self-efficacy, enjoyment, barriers, family and peer support to be
4 positively associated with physical activity levels in adolescent girls (Biddle,
5 Whitehead, O'Donovan, & Neville, 2005). There is also evidence to indicate the
6 mediating role of self-efficacy, perceived barriers, perceived benefits and enjoyment
7 of intervention effects on physical activity behavior (Lubans, Foster, & Biddle, 2008).
8 Yet, research investigating the explanatory power of social-cognitive models for
9 adolescent physical activity behavior is limited (Plotnikoff, Costigan, Karunamuni, &
10 Lubans, 2013). In their recent review and meta-analysis, Plotnikoff and colleagues
11 (2013) revealed the TPB was the most commonly tested model in adolescents, but that
12 most of the variance in physical activity remains unexplained. The authors found that
13 three studies had evaluated models based on SCT and that no studies had tested the
14 utility of Bandura's (2004) reconceptualized model in adolescents.

15   Ramirez and colleagues (2012) examined an abridged version of Bandura's
16 (2004) model to explain physical activity in children using an objective measure of
17 behavior (step counts by pedometers). Yet, the model was not well supported. Only
18 2% variance in physical activity was explained and goals emerged as the only direct
19 determinant of behavior. In a recent cross-sectional study, Martin et al. (2011)
20 examined the capacity of several SCT constructs to directly predict self-reported
21 physical activity in a sample of middle school students. Only a small proportion of the
22 variance in physical activity was accounted for by the model (12%), and only barriers
23 self-efficacy and classmate social support were found to predict physical activity. In
24 comparison, Taymoori et al. (2010) found stronger support for their SCT model when
25 tested in adolescent girls which explained 52% of the variance in physical activity. In

1 their model, direct effects from barrier self-efficacy and outcome expectations, and
2 indirect effects from parental and peer social support through self-efficacy on physical
3 activity were reported.

4 Identifying appropriate health behavior theories is essential for improving our
5 understanding of behavior change and designing effective interventions. Indeed, there
6 is good evidence to show that interventions guided by theory are more likely to
7 produce stronger effects than interventions developed without theory (Ammerman,
8 Lindquist, Lohr, & Hersey, 2002). However, the existing evidence base for children
9 and adolescents is limited (Plotnikoff et al., 2013). In their recent review of adolescent
10 studies, Plotnikoff and colleagues (2013) identified an over-reliance on cross-
11 sectional designs, and the need for more rigorous and applied theory tests using
12 longitudinal and experimental studies. The authors also expressed concern for the
13 almost exclusive use of self-report measures of physical activity for tests of theory as
14 only two studies had used objective measures of physical activity. Self-report
15 measures have been criticized for their questionable accuracy due to response bias and
16 the difficulty that young people have recalling their behavior (Sallis & Saelens, 2000).

17 As such, the aim of this study was to test the proposed structural paths of
18 Bandura's 2004 SCT model to explain objectively measured physical activity over a
19 12-month period in a sample of adolescent girls.

20 21 **Method**

22 **Study design**

23 Data from the Nutrition and Enjoyable Activity for Teen Girls (NEAT Girls)
24 group randomized control trial (Lubans et al., 2010; Lubans et al., 2012) were
25 examined and reported in the present study. NEAT Girls is a 12-month multi-

1 component school-based obesity prevention intervention which targeted adolescent
2 girls from schools in low-income communities. Ethics approval for NEAT Girls was
3 obtained from the University of Newcastle, Australia and the New South Wales
4 Department of Education and Training Human Research Ethics Committees. School
5 Principals, study participants and their parents provided written informed consent to
6 participate in the program which commenced in July 2010.

7 **Participants**

8   The Socio-Economic Indices for Areas (SEIFA) index of relative
9 socioeconomic disadvantage (scale 1 = lowest to 10 = highest) was used to identify
10 eligible secondary schools from low-income communities which establishes summary
11 characteristics of people and households within a school's locality (employment,
12 education, financial well-being, housing stress, overcrowding, home ownership,
13 family support, family breakdown, family type, lack of wealth, low income,
14 Indigenous status and foreign birth) (Australian Bureau of Statistics, 2001). Eligible
15 schools were Government secondary schools with a SEIFA index of ≤ 5 (lower 50%)
16 from the Hunter and Central Coast regions of New South Wales. Twelve schools were
17 recruited, from which 357 adolescent females consented to participant (i.e.,
18 approximately 30 participants per school). Physical Education (PE) teachers at the
19 participating schools identified and recruited students who were at risk for physical
20 inactivity. That is, eligible students included those who were often disengaged and
21 resisted participation during PE, and reported no current involvement in organized
22 team or individual sports outside of school.

23 **Model tested**

For the current study, baseline cognitions were hypothesized to predict physical activity at 12-month month after adjustment for baseline physical activity. That is, self-efficacy, outcome expectations and proximal goals would directly predict MVPA at 12-months (controlling for baseline physical activity), and that outcome expectations, proximal goals, and facilitators would also mediate the relationship between self-efficacy and MVPA change. How the social-cognitive variables were targeted in the NEAT Girls intervention is explained previously in detail (Lubans et al., 2010). Because barriers self-efficacy was specifically examined, impediments were not included as proposed in Bandura's 2004 model. According to Bandura (2004), intentions can be considered proximal goals to perform a behavior, hence proximal goals have been included in the model as a measure of intention. Finally, parental support was used to represent facilitators of physical activity in the model. This is based on the most consistent evidence for parental support to be an important correlate of physical activity in adolescent girls specifically (Biddle et al., 2005). While there is some evidence for peer support to be associated with adolescent physical activity (e.g., Ferreira et al., 2007), other research has deemed this relationship to be indeterminate (Sallis, Prochaska, & Taylor, 2000). Moreover, the parental support measure included in the models assessed multiple dimensions of social support, including mutual participation in physical activity (i.e., parent and child together), provision of equipment and opportunities to support participation in physical activity and general encouragement

Outcome measures

Data were collected in May/June of 2010 [T1] and 2011 [T2] at the study schools by trained research assistants (RA). The social cognitive measures were completed by study participants at T1 in exam-like conditions. Accelerometers were

distributed on the same day that participants completed the social cognitive measures at T1 and were to be worn by participants for the following seven days. The procedure for accelerometers was repeated again at T2.

Height and weight. Participants' weight was measured in light clothing without shoes using a portable digital scale (Model no. UC-321PC, A&D Company Ltd, Tokyo Japan) to the nearest 0.1kg. Height was recorded to the nearest 0.1 cm using a portable stadiometer (Model no. PE087, Mentone Educational Centre, Australia). From this, body mass index (BMI) was calculated [$\text{weight(kg)}/\text{height(m)}^2$] and BMI-z scores were also derived to determine weight status using the 'LMS' method (Cole et al., 2000). BMI z-scores provide a relative measure of adiposity adjusted for age and sex in children. A z-score is the number of standard deviation (SD) units that a person's BMI has deviated from a mean or reference value. Hence for the current study, overweight and obese is defined as ≥ 1 and ≥ 2 SD units from the mean value respectively.

Physical activity. Actigraph accelerometers (MTI models GT1M and GT3X; ActiGraph, LLC, Fort Walton Beach, FL) were used to collect physical activity data at baseline and 12-months. Comparisons of the output generated by the various Actigraph accelerometers suggests that the data are comparable for estimating physical activity (John, Tjo, & Bassett, 2010). Participants were asked to wear the devices for seven consecutive days, except while bathing and swimming. Uniaxial data were collected and stored in 30-second epochs and age specific cut-points were used to categorize physical activity into moderate (1148 – 2005 counts) and vigorous (≥ 2006 counts) intensity activity (Trost, Loprinzi, Moore, & Pfeiffer, 2011). Non-wear time was determined by strings of consecutive 0 counts ≥ 20 minutes, allowing an interruption interval of one minute of counts between 0 and 100. Data were only

1 included in the analyses for cases where wear time ≥ 600 minutes per day for at least
2 3 days.

3 **Social cognitive scales for physical activity.** Four social cognitive scales
4 related to adolescent physical activity behavior were used: self-efficacy, intention,
5 parental support and outcome expectations related to physical activity (Dewar,
6 Lubans, Plotnikoff, & Morgan, in press). The scales are based on constructs from the
7 SCT and were previously tested in a separate adolescent sample ($n = 171$, mean age
8 13.6 ± 1.2 years). Reliability (2 week test-retest) and internal consistency for each
9 scale are identified below. The introduction to each scale included a referent which
10 asked respondents to specifically consider participation in regular MVPA when
11 responding to each item. Regular MVPA was defined as *“participating in a total of*
12 *60 minutes of at least moderate intensity activity on all or most days of the week”*,
13 and suitable examples were provided. This referent was important to ensure that the
14 cognitions for behavior were matched with the physical activity outcome (i.e.,
15 MVPA) used in the analyses.

16 *Self-efficacy.* The five-item self-efficacy measure primarily measured barriers
17 efficacy which was operationalized as an individual’s belief in their ability to
18 overcome barriers to participation in MVPA ($ICC = .91$, $\alpha = .69$). For example – *“I*
19 *find it difficult to be physically active when I’ve had a busy day”*. Each item was
20 measured on a six-point Likert-type scale of 1 (*strongly disagree* indicating very low
21 efficacy beliefs) to 6 (*strongly agree* indicating very strong efficacy beliefs).
22 Negatively worded items were reverse coded. For each individual, a composite self-
23 efficacy score was obtained by calculating an average (score out of six) from the five
24 efficacy items.

1   *Intention.* Intention was operationalized as an individual's intention to
2 participate in MVPA on most days of the week over the next *three months*. Intention
3 was examined with a single item using a four-point Likert-type scale of 1 (*not at all*
4 *true of me* indicating no intention), to 4 (*very true of me* indicating strong intention).

5   *Parental support.* Parental support for MVPA was examined as a facilitator of
6 physical activity as per the facilitators/impediments determinant in Bandura's
7 proposed model. On a five-point Likert-type scale of 1 (*never* indicating no parent
8 support received) to 5 (*always* indicating very frequent parental support), four items
9 (ICC = .86, $\alpha = .74$) assessed a variety of supportive behaviors received from parents
10 to participate in MVPA. For example – “...*did your parents buy you equipment that*
11 *encouraged you to be physically active (e.g., sports clothes, joggers, a bike, an i-pod*
12 *for listening to music while being physically active?*”). A composite parental support
13 score was obtained by calculating an average score (out of five) for the four parental
14 support items.

15   *Outcome expectations.* The outcome expectations measure examined the
16 anticipated physical (e.g., “*participation in regular physical activity can help me to*
17 *control my weight better*”) and social (e.g., “*participation in regular physical activity*
18 *with friends can be fun*”) benefits of participating in regular physical activity. Five
19 items were rated on a six-point Likert-type scale of 1 (*strongly disagree* indicating no
20 benefit expected) to 6 (*strongly agree* indicating very positive benefits expected)
21 (ICC = .82 and $\alpha = .75$). A composite outcome expectations score was obtained by
22 calculating an average score (out of six) from the five expectation items.

23   **Analysis**

SPSS 19.0 software (IBM, SPCC inc. Chicago, IL) was used to calculate the univariate normality, means, and standard deviations for each variable, and the bivariate correlations between the social cognitive and physical activity variables. Data were transformed using the base 10 logarithmic function to improve normality where necessary. Intraclass correlation coefficients (ICC) were calculated to determine the total variability in physical activity that could be explained at the school level. As the ICC values were low (i.e., 4%), the analyses were not adjusted for school. Maximum likelihood analysis (MLE) in AMOS 19.0 (Small Waters Corp. Chicago, IL) was used to examine structural equation modeling (SEM). SEM is an appropriate method for testing health behavior theories as it allows researchers to test multiple pathways simultaneously and can include variance estimates for more than one dependent variable (Bollen & Long, 1993). The model included baseline social cognitive constructs predicting MVPA at 12 months (controlling for baseline activity). For parsimony and given sample size ($N = 235$), the model included single indicator latent variables which accounted for measurement error, while minimizing the number of model parameters.

As the preferred criteria for model evaluation, Hu and Bentler (1999) recommend a two-index presentation strategy. This includes using the MLE-based standardized root mean squared residual (SRMR) because this is the most sensitive index to models with latent structure(s), and supplementing the SRMR with an incremental fit index (i.e., either the Comparative Fit Index (CFI), Tucker-Lewis index [TLI], Relative Non-centrality Index [RNI], Bollen's Fit Index [BL89], McDonald's Centrality Index [Mc] or the Root Mean Square Error of Approximation [RMSEA]) which are the most sensitive indexes to models with mis-specified factor loadings (Hu & Bentler, 1999). It has been found that a presentation strategy

1 including SRMR and RNI or CFI resulted in the least sum of Type I and Type II error
2 rates and so may be a preferred combination. Hence SRMR and CFI are currently
3 reported. In sample sizes < 250 , when using combinational rules of SRMR and CFI,
4 acceptable fit indices recommend values < 0.09 and > 0.95 respectively (Hu &
5 Bentler, 1999). Correlations between variables were interpreted as follows: 0-0.19
6 (no correlation), 0.2-0.39 (low correlation), 0.4-0.59 (moderate correlation), 0.6-0.79
7 (moderately high correlation), ≥ 0.8 (high correlation) (Safrit & Wood, 1995; Zhu,
8 2012).

9 **Results**

10 **Descriptive statistics and bivariate correlations**

11 For the current analyses, the sample included 235 adolescent girls from 12
12 secondary schools located in low-income communities. This sample size is based the
13 number of participants with eligible accelerometer data at baseline (i.e. ≥ 600 minutes
14 wear time per day for at least 3 days). Demographic information at baseline revealed
15 participants (13.2 years, $SD = 0.4$) to be predominantly Australian born (97.0%), to
16 speak English at home (98.7%) and to acknowledge their cultural background as
17 Australian (86.9%). The percentage of participants classified as overweight and obese
18 were 24.6% and 14.4%, respectively. There was a slight decline in daily MVPA (39.6
19 minutes) from baseline (T1) to 12-months (T2) (34.4 minutes). Descriptive statistics
20 and bivariate correlations between social cognitive variables (T1) and PA (T1 and
21 T2) are presented in Table 1. In summary, correlations between social cognitive
22 variables ranged from low ($r = 0.25$) to moderate ($r = 0.48$) However, none of the
23 social cognitive variables were associated with physical activity at T1 or T2.

24 **Structural model findings**

In the model predicting objectively measured MVPA at 12-months, 28% and 34% of the variance in behavior and intention were explained (Figure 1). Fit statistics indicated the data fit the specified model ($\chi^2 = 11.36$, $df = 6$, $p = .08$, CFI = .97, SRMR = 0.06 and standardized path estimates ranged from -0.18 to 0.67 (Figure 1). Between the social cognitive determinants, three of the five proposed pathways were supported [from self-efficacy to parental support ($\beta = .67$, $p < .001$) and outcome expectations ($\beta = .42$, $p < .001$), and from outcome expectations to intention ($\beta = .54$, $p < .001$)]. The proposed relationships to intention from both self-efficacy and facilitators/impediments to intention were not supported. Finally, there was a low correlation between self-efficacy ($\beta = .26$) and MVPA at 12-months.

Discussion

To the authors' knowledge this is the first study to examine the utility of SCT to explain physical activity over a 12-month period in adolescent girls of low-SEP and the findings may have important implications for future research guided by evidence-based theory. The results demonstrate that the SCT constructs explained only 28% of the variance in physical activity at 12-months. Contrary to the tenets of SCT, after adjusting for baseline physical activity, only self-efficacy was associated with behavior at 12-months. Together these findings suggest the model may require further development when attempting to accurately explain the antecedents of behavior change in this particular group.

Although the proposed model provided a good fit to the data, the majority of the variance in physical activity and intention remain unexplained. Most of the variance explained in our model is probably due to adjustment for past behavior. Common method artifact may explain the weak bivariate correlations between the

1 social-cognitive variables and objectively measured behavior. These findings are
2 consistent with a recent meta-analysis of the predictive power of key social-cognitive
3 theories amongst adolescents, which showed the variance explained for physical
4 activity (33%) and intention (48%) was moderate (Plotnikoff et al., 2013). As such, it
5 may be necessary for future research to revise and/or integrate current theory in order
6 to advance our understanding of physical activity in the adolescent population.

7 Rhodes and Nigg (2011) discuss testing augmentation of theoretical models with
8 additional physical activity constructs. This procedure can offer rigor to the original
9 model if the additional constructs fail to improve the explained variance of the
10 behavior. For example, in a recent test of the SCT model in adolescent girls, Lubans
11 and colleagues (2011) added the construct physical self-worth to the model which was
12 hypothesized to directly and indirectly predict objectively measured physical activity
13 through physical activity behavioral strategies and outcome expectations. The
14 rationale for including this construct in the model was based on findings from earlier
15 research which has shown self-worth to be a predictor of physical activity and an
16 outcome of exercise in adolescent girls (Crocker, Sabiston, Kowalski, McDonough, &
17 Kowalski, 2006). Their findings showed physical self-worth was associated with
18 physical activity, however, the model explained only a small amount of the variance
19 (5%) in behavior.

20 Augmentation can also support integration of theoretical models, by
21 combining constructs which have shown promise for explaining physical activity
22 from across two or more theories to develop unique models of behavior. For example
23 Hagger and Chatzisarantis (Hagger & Chatzisarantis, 2009) demonstrated the
24 potential utility of hybrid theory by performing a meta-analysis of studies integrating
25 the TPB and Self Determination theories (SDT) in a variety of health contexts. The

findings showed support for a sequence of self-determined motivation from SDT to predict the antecedents of intentions and behavior from the TPB. Furthermore, pooled results accounted for a reasonably large variance in intention (65%) and behavior (58%) when compared to the explanatory power of single theoretical models in Plotnikoff et al. (2013) more recent meta-analysis (48% and 33% respectively).

There may also be considerable value in exploring combined models of social cognition with other ecological components (e.g., individual, interpersonal, community, organization and policy factors) (Hagger, 2009; Plotnikoff et al., 2013).

The case for this approach is strengthened when we consider the preoccupation with intrapersonal level constructs that models of social cognition are limited by, yet there is good evidence to support environmental influences of physical activity behavior in youth including policy and community setting influences (e.g., Ferreira et al., 2007).

Besides poor variance explained, the current results demonstrate difficulty in linking the social-cognitive variables to behavior. Self-efficacy was the only cognition to directly predict behavior change. The support for self-efficacy is consistent with previous studies that have demonstrated the importance of efficacy beliefs in explaining adolescents' physical activity behaviors (Lubans et al., 2008; Plotnikoff et al., 2013). For example, in cross-sectional and longitudinal tests of the SCT and HPM, self-efficacy has emerged as a consistent predictor of physical activity among various adolescent groups (Martin et al., 2011; Taymoori et al., 2010). Meanwhile, there is also good support for self-efficacy in its role to mediate intervention effects on physical activity behavior change among children and adolescents (e.g., Taymoori & Lubans, 2007). While the current study examined barrier self-efficacy specifically, together these findings demonstrate that strategies to increase adolescents' self-

1 efficacy for physical activity are justified and should be addressed when attempting to
2 improve physical activity behavior in this group.

3   The current study did not support the predictive capacity of intention, due to
4 the small percentage of variance explained. The study sample indicated strong
5 intention to be physically active at baseline and it is possible that anticipation of
6 participating in a physical activity intervention had an acute positive effect on their
7 intention to be physically active. On the other hand, research reporting intention-
8 behavior discordance in the physical activity domain is not new. During their recent
9 meta-analysis of experimental evidence, Rhodes and Dickau (2012) demonstrated the
10 intention-behavior association to be very weak and not meaningful, and suggested that
11 prior evidence to support this association was probably biased by the limits of
12 correlation coefficients in passive research designs.

13   Closing the intention-physical activity gap has been addressed in the literature,
14 and may start with better measurement of the intention construct. For the current
15 study intention was examined using a single item. Although this is common practice
16 (Rhodes & Dickau, 2013), it has been suggested that rudimentary measurement using
17 a single item may not be sufficient to assess the concept as originally defined (Ajzen,
18 1991). Research has also attempted to indentify constructs which may bridge the gap
19 between intention and behaviour through theory augmentation. For examples, models
20 which focus on mediators of the intention have emerged, suggesting intention may not
21 be the direct antecedent of physical activity as originally theorised, but a more distal
22 determinant in a longer causal chain (e.g., Sniehotta, 2009). For instance, self-efficacy
23 and strategic planning have emerged as post-intentional factors that lead to actual
24 behavior. Moderating mechanisms have also been explored to help understand
25 intention-behavior discordance. For example, in their recent review Rhodes and

Dickau (2013) found intention stability to be the most consistent moderator of the intention-physical activity gap, whereby higher stability represented a larger intention-physical activity coefficient. The authors found anticipated regret, conscientiousness, self-efficacy, planning, extraversion, habit and environmental proximity to recreation also showed evidence for moderation. While moderators do not challenge intention as a proximal influence on physical activity behavior, evidence for moderating mechanisms can help identify which factors impede or facilitate the translation of intentions into behavior. Hence it has been suggested that augmented models that focus on action control (i.e., translating an intention into behavior) may be more practical for explaining physical activity than models which assume intention is the proximal influence of behavior that is adequate to produce a repeated behavioral act (Rhodes & Dickau, 2012).

Similarly, positive outcomes expected by the study sample did not translate to behavior, hence exploring if additional constructs impact the relationship between expected outcomes and physical activity behavior in this group may also be warranted. For example, following an online physical activity and dietary intervention, Anderson-Bill and colleagues (2011) found outcome expectations had an indirect positive effect on physical activity through modification of self-regulatory behaviors. Another possibility is exploring expectancy value (i.e., outcome expectancies) as a dichotomous moderating mechanism (i.e., high versus low) between outcome expectations and physical activity. Outcome expectancies are concerned with personal value placed on the perceived benefits of a health behavior (e.g., improving my physical fitness through physical activity is important to me/is not important to me). It is possible that adolescents recognize the many benefits

1 associated with physical activity, yet if personal value is not placed on these benefits
2 then this knowledge may not directly translate well to positive behavior change.

3   In the SCT model, self-efficacy, outcome expectations and parental support
4 were hypothesized to be proximal determinants of intention, however only the
5 pathway between outcome expectations and intention was supported. Failure to detect
6 a significant relationship between self-efficacy and intention could be due to limited
7 measurement of efficacy beliefs. For the current study barriers self-efficacy was
8 included, and it may be necessary to additionally examine other forms of self-efficacy
9 (e.g., task-efficacy or any of the different components of regulatory-efficacy) to more
10 accurately determine the strength of the efficacy-intention relationship. Further, the
11 absence of a meaningful association between parental support and intention could be
12 because we did not additionally examine impediments to physical activity behavior in
13 the models, and our measure of parental support provided a limited assessment of
14 potential facilitators of participation in physical activity. For example, peer/sibling
15 support, or physical environmental influences are also important influences to
16 explore. Even so, future model testing may be encouraged to examine parental
17 support as a direct influence on physical activity in this group. Parental support has
18 emerged as an important correlate and direct determinant of physical activity in
19 adolescent girls (Biddle et al., 2005; Peterson et al., 2013).

20   In comparing the current findings with other research in adolescent girls,
21 support for the SCT is weaker than previously reported. For example, a slightly
22 alternative SCT model tested by Taymoori and colleagues (2010) accounted for a
23 larger variance in physical activity (52%), and supported self-efficacy as a direct and
24 indirect (through outcome expectations) influence on physical activity behavior.
25 Further our model did not support the role of social support to predict behavior

1 through intention. Yet the model tested by Taymoori et al. (2010) suggests social
2 support (parental and peer) may rather influence physical activity when treated as an
3 antecedent of self-efficacy. Comparing findings between studies however should be
4 made with caution. The current study included a 12-month follow-up assessment and
5 assessed physical activity using accelerometers. Meanwhile Taymoori and colleagues
6 (2010) performed a cross-sectional analysis using a self-report measure of physical
7 activity, and it is possible that study design and common method artifact regarding
8 measurement of variables may have biased results. Even so, there is very little
9 research testing the utility of social cognitive theories in adolescent girls, and clearly
10 continued efforts with strong study designs are needed to achieve more conclusive
11 evidence in this group.

12 In conclusion, acceptable model fit indices did support the SCT model in this
13 study. However, only a small proportion of the variance in objectively measured
14 physical activity was explained. While the majority of previous research in this area
15 has been cross-sectional, our study included 12-month follow-up assessments. After
16 adjusting for baseline physical activity, there was a low correlation between self-
17 efficacy and physical activity at 12-months. Contrary to the tenets of SCT, there was
18 no correlation between outcome expectations, intentions and physical activity.

19 ***Strengths and limitations***

20 To the authors' knowledge this is the first study to test the utility of SCT to
21 predict objectively measured physical activity over a 12-month study period in
22 adolescent girls. Furthermore, the study sample represented an underserved adolescent
23 population who have been identified as requiring priority attention. However, there
24 are some limitations that also should be noted. The original intervention sample
25 included 357 girls, yet due to attrition of usable accelerometer data, the sample used

1 in the current study included 235 girls. Hence, the findings are not representative of
2 the complete intervention sample. Intention was examined using a single item
3 measure, and it is also important to note that the self-efficacy measure included items
4 that pertained only to barriers-efficacy, hence why impediments to physical activity
5 were not examined. Finally, due to the sample size limiting model parameters,
6 parental support was the only factor included as a facilitator to physical activity.

7 ***What does this study add?***

8 In summary, the tenets of Bandura's reconceptualized SCT model were not
9 supported in a sample of adolescent girls and only a small proportion of variance in
10 physical activity was explained. Further research is needed to explore the interaction
11 between the SCT constructs and behavior, and expand the hypothesized pathways. For
12 example, future studies may consider augmentation of theoretical models to account
13 for evidence based moderators and mediators in closing intention-physical activity
14 discordance. Similarly, research may focus more on the predictive power of integrated
15 theories when attempting to understand the driving mechanisms underlying adolescent
16 physical activity behavior (Hagger, 2009). That is, using exploratory analyses to
17 combine constructs and hypothesized structural pathways from several theories of
18 health behavior may be necessary to accurately establish how adolescent physical
19 activity behavior is influenced in this group. Finally, there is also a need for more
20 research to investigate the explanatory power of health behavior theories using
21 objective measures of physical activity. For example, accelerometers provide a more
22 accurate estimate of behavior than self-report measures (Sallis & Saelens, 2000)
23 which to date have been the dominant method for physical activity measurement in
24 this line of research (Plotnikoff et al., 2013).

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