

TESTING AN INTERVENTION TO INCREASE ADOLESCENT AUTONOMOUS
MOTIVATION FOR PHYSICAL ACTIVITY AND MODERATE-TO-VIGOROUS
PHYSICAL ACTIVITY AMONG RURAL, ADOLESCENTS

By

Karla Palmer

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Nursing – Doctor of Philosophy

2022

ABSTRACT

Daily moderate to vigorous physical activity (MVPA) is critical for high school (HS) students in rural areas who are not meeting physical activity (PA) guidelines. HS students who are not involved in sports and other activities that help them meet current PA recommendations need additional programs to assist them in achieving this objective. Although PA is vital to their health, limited research has evaluated PA interventions with rural HS students. The two-fold purpose of this dissertation is: (1) Examine autonomous motivation for PA; and (2) Test the acceptability, feasibility, and preliminary efficacy of a PA intervention with rural HS students. The dissertation aims are: (1) To analyze the concept of adolescent autonomous motivation for PA, (2) To test the preliminary efficacy of a 10-week Teen Leisure Time PA Club (TLC) intervention among rural HS students, as compared to a control condition, in: a) increasing MVPA (primary outcome; min/hr.; accelerometer-measured) and decreasing sedentary behavior, body mass index (BMI), percent body fat (% BF), and perceived stress; and b) improving psychosocial (basic psychological needs [BPNs]: competence, autonomy, and relatedness and autonomous motivation for PA), (3) Evaluate the feasibility of the intervention related to: HS students' enrollment, attrition, and attendance in the club; delivery/receipt of avatar motivational messages and weekly PA goals and strategies; and adherence to protocols, (4) To explore HS students' and club instructors' satisfaction with the intervention (individual interviews).

Manuscript 1 is a concept analysis of adolescent autonomous motivation for PA. The review utilized Rodger's Evolutionary Model of concept analysis. Five online databases were searched for studies published in English utilizing key words, such as adolescents/teenagers, motivation, autonomous motivation, and PA. The results yielded 1971 records, with 68 articles meeting eligibility criteria. Findings demonstrate that adolescent autonomous motivation for PA

is conceptually defined as a personal desire to attain PA because the behavior is fun and enjoyable, or it is an important part of how the adolescent self-identifies. Manuscript 2 and 3 are based on data designed to evaluate a PA intervention. Two rural school districts were approached to participate and students were recruited from their home room classes during school hours. The study population included HS students in grades 9 through 12 that were willing to participate. Manuscript 2 examines quantitative findings from this original intervention study. Measures included the primary outcome of MVPA (via ActiGraph); and secondary outcomes of sedentary behavior, perceived stress, BMI, %BF, and self-report PA. No differences in accelerometer measured or self-reported PA emerged between the intervention and control groups at baseline and post-intervention. Retention rates (83%) and positive feedback from participants supported the intervention's acceptability. Enrollment rate was very low (1.88%). No between-group differences occurred in any of the measured variables. Manuscript 3 examined qualitative data from semi-structured interviews conducted with a sub-sample of 10 HS students. Interviews explored adolescents' perceptions of their experiences with the TLC and the degree that the environment was autonomy-supportive. Recorded interviews were transcribed, and two independent reviewers coded the data. Findings showed that these concepts (BPNs and environmental variables) are important and help support autonomous motivation for PA. In summary, this study, guided by the Self-Determination Theory (SDT) established that adolescent autonomous motivation for PA may contribute to increase PA in rural HS students and that the TLC intervention was acceptable, and feasible.

This dissertation is dedicated to my wonderful husband, Chad Palmer, and my children, Tim, Natalie, and Lindsey for their love, support, and encouragement to help me believe in my dreams.

ACKNOWLEDGEMENTS

Appreciation of adolescent participants

Guidance/dissertation committee

Funders/financial support

Fellow students

Friends

Family

Dissertation Funding

This dissertation was partially funded by a grant from Jonas Philanthropies, Sigma Theta Tau International, Alpha Psi Chapter Scholarship, Youth Action Coalition, Dissertation Completion Fellowship, and support from the National League for Nursing Foundation for Nursing Education Scholarship.

Support for my doctoral education included scholarships from Michigan State University College of Nursing including the: Glenn R. Dean and Anita C. Dean Fellowship.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS.....	vii
CHAPTER ONE: INTRODUCTION.....	1
REFERENCES.....	31
CHAPTER TWO: ADOLESCENT AUTONOMOUS MOTIVATION FOR PHYSICAL ACTIVITY: A CONCEPT ANALYSIS	39
REFERENCES.....	67
CHAPTER THREE: FEASIBILITY, ACCEPTABILITY, AND PRELIMINARY EFFICACY OF TEEN LEISURE TIME PHYSICAL ACTIVITY CLUB: A PHYSICAL ACTIVITY INTERVENTION FOR RURAL, HIGH SCHOOL STUDENTS.....	75
REFERENCES.....	94
CHAPTER FOUR: PERSPECTIVES OF HIGH SCHOOL STUDENTS INVOLVED IN A MULTI-COMPONENT, AFTER-SCHOOL PHYSICAL ACTIVITY INTERVENTION	99
REFERENCES.....	123
CHAPTER FIVE: CONCLUSIONS	127
REFERENCES.....	139
APPENDIX A: Parent/Guardian Consent Form and Adolescent Assent	142
APPENDIX B: Parent/Guardian Survey.....	148
APPENDIX C: Personal Factors and Behavior Survey: Screening Tool for Adolescent Participants.....	151
APPENDIX D: Perceived Autonomy Support in Exercise Settings Questionnaire	157
APPENDIX E: Behavior Regulation in Exercise Questionnaire – 3 (BREQ3).....	159
APPENDIX F: Basic Psychological Needs in Exercise Score (bPNES).....	161
APPENDIX G: TLC Intervention Evaluation Instrument	163
APPENDIX H: TLC Peer Delivered Avatar Messages Evaluation.....	164
APPENDIX I: TLC Mascot Delivered Weekly PA Goal and Strategies Messages Evaluation	166

LIST OF ABBREVIATIONS

% BF	Percent body fat
BMI	Body Mass Index
BPNs	Basic Psychological Needs
CINAHL	Cumulated Index to Nursing and Allied Health Literature
CDC	Centers for Disease Control and Prevention
ERIC	Education Resources Information Center
HS	High School
MVPA	Moderate to vigorous physical activity
PA	Physical activity
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
SDT	Self-determination Theory
TLC	Teen Leisure time physical activity Club
U.S.	United States
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

United States (U.S.) Youth Risk and Behavior Survey (YRBS, 2019) data show that 14.8% of HS students are obese, and another 15.6% are overweight. Moreover, PA behaviors adopted during adolescence are likely to be maintained into adulthood, making this stage of life an important time to participate in and promote PA (National Alliance of Youth Sports, 2018; Oluwasanu & Oladepo, 2017; Reinehr, 2018). Obesity is defined as a BMI at or above the 95th percentile, and overweight is defined as a BMI between the 85th and below the 95th percentile for adolescents of the same age and sex (Centers for Disease Control and Prevention [CDC], 2020). Michigan is the fifth highest state in the U.S. for adolescent obesity rates (Robert Wood Johnson Foundation, 2019), indicating the seriousness of the problem. In addition, rural adolescents have a 26% greater risk of obesity, as compared to their urban counterparts (Euler et al., 2019). The high percentage is a concern because obesity tracks from adolescence into adulthood (WHO, 2020).

In the U.S., the most recent projections report that by 2030 more than 85% of adults will be overweight or obese (Hruby & Hu, 2015), indicating an urgent need for intervention before adulthood is reached. Although adolescence is an ideal time to intervene (Dishman et al., 2018; National Alliance of Youth Sports, 2018; Oluwasanu & Oladepo, 2017; Reinehr, 2018), interventions to increase adolescents' PA have had limited effectiveness. Interventions that increase their autonomous motivation for PA may be key (Ntoumanis et al., 2020). Although PA interventions have been tested among urban HS students, the approaches and related findings cannot be generalized to rural HS students, due to differences in their physical environment (e.g., limited access to PA opportunities or increased distance to facilities; Barnidge et al., 2013; Cleland et al., 2015). Another approach that is lacking is the use of autonomy-supportive PA

environments in the after-school setting for rural HS students. An autonomy-supportive PA environment provides support for the basic psychological needs (BPNs; competence, autonomy, and relatedness) and moves motivation along the continuum in a positive direction (Gillison et al., 2009; Mouratidis & Michou, 2011).

Dissertation Aims:

- 1) To analyze the concept of adolescent autonomous motivation for PA (Manuscript 1).
- 2) To test the preliminary efficacy of a 10-week Teen Leisure Time PA Club (TLC) intervention among rural, HS students, as compared to a control condition, in: a) increasing MVPA (primary outcome; min/hr.; accelerometer-measured) and, decreasing sedentary behavior, BMI, % BF, and perceived stress; and b) improving psychosocial (BPNs: competence, autonomy, and relatedness; and autonomous motivation for PA; Manuscript 2).
- 3) To evaluate the feasibility of the intervention related to: HS students' enrollment, attrition, and attendance in the club; delivery/receipt of avatar motivational messages and weekly PA goals and strategies; and adherence to protocols (Manuscript 2).
- 4) To explore HS students' and club instructors' satisfaction with the intervention (individual interviews and surveys; Manuscript 3).

This dissertation will use the three-manuscript format. Specific research questions will be introduced with each manuscript in Chapters 2-4.

Background and Significance

Physical inactivity strongly increases the risk of obesity (OR 3.9, 95% CI, 1.4-10.9; Pietiläinen et al., 2008). Physical inactivity plays a key role in the development and management of obesity; while obesity impacts negatively on an adolescent's PA level (Hohepa, Schofield, &

Kolt, 2004; Pietiläinen et al., 2008). The World Health Organization (WHO, 2020) estimates that as many as 1.9 million deaths worldwide are due to physical inactivity. Adolescents in rural areas have 20.42 minutes/day more sedentary activity than those in urban areas (Euler et al., 2019). Adolescents in rural areas also have 8.17 minutes per day lower MVPA than urban adolescents (Euler et al., 2019). Inadequate PA represents the non-achievement of recommended PA guidelines calling for at least 60 minutes of mostly MVPA every day (Thivell et al., 2018). Therefore, the promotion of PA is an essential public health strategy to improve the health of adolescents (WHO, 2020).

Of the 40 million U.S. children who participate in sports each year, about 70% will drop out by the time they turn 13 (National Alliance of Youth Sports, 2018). PA begins to decline during adolescence, resulting in increased weight gain. This problem makes HS students (low or inactive, males and females in 9th through 12th grade) a key population to focus on for developing PA interventions that are outside of sports participation (Dishman et al., 2018; National Alliance of Youth Sports, 2018; Oluwasanu & Oladepo, 2017; Reinehr, 2018). Sedentary behavior is characterized by an energy expenditure of ≤ 1.5 METs while in a sitting, lying, or reclining position (Thivell et al., 2018). MVPA is a category of activity intensity that requires some heavy breathing with exercise (Evenson et al., 2008) and accelerations via an ActiGraph with pre-established cut points of $MVPA \geq 2,296$ counts/minute (Evenson et al., 2008). Reducing sedentary behavior and increasing PA is a major focus for obesity prevention among adolescent populations.

Promotion of PA continues to be a priority for improving HS students' health and well-being. Evidence is indisputable regarding the effectiveness of regular PA for the primary and secondary prevention of several diseases, such as depression, type 2 diabetes, cancers, and

cardiovascular disease. Increasing rural, HS student's MVPA and reducing their sedentary behavior is critical for attaining or maintaining a healthy weight. Many rural HS students also have higher levels of perceived stress (Euler et al., 2019; Johnson & Johnson, 2014), due to challenges faced in rural areas (e.g., poverty, distance-related issues) as compared to urban HS students (Stults-Kolehmainen & Sinha, 2014). Perceived stress is defined as the degree to which individuals appraise that their demands exceed their coping skills (Cohen, 1994). PA has been found to be associated with lower perceived stress (Stults-Kolehmainen & Sinha, 2014) and is identified as a positive strategy to manage HS students' stress and increase their resistance to stress (Ratey & Hagerman, 2008). Therefore, assisting rural, HS students to increase their PA to manage their high stress level is a priority.

In-school interventions. Many past approaches to address PA for adolescents, including those of HS age, have attempted to do so in the school setting, typically in the physical education (PE) setting. However, the effects of these school-based interventions on PA were small for adolescents (standardized mean difference [SMD] = .02-.19; Borde et al., 2017; Van de Kop et al., 2019) indicating the need for other approaches.

Only two in-school intervention studies were found that focused on increasing PA among rural HS adolescents. "The Planning to be Active" study, based on the Social Cognitive Theory (SCT; Hartz & Petosa, 2006), showed that implementing an activity-based PE curriculum with eight skill-building lessons integrated into the existing curricula resulted in increased self-reported leisure time MVPA post-intervention. Unfortunately, the HS students self-reported their PA, and the researchers reported difficulty working with school districts to change the existing required curricula during the school day (Hartz & Petosa, 2006). Moreover, the researchers provided incentives to increase PA during the intervention (Hartz & Petosa, 2006) an approach

that is not sustainable. Based on both the Social Ecological Model (SEM) and the SC, the other study (Pate et al., 2005) tested an intervention that included both health lessons during the school day and a supportive family environment. The study showed higher rates of PA one year after the intervention had ended; however, this intervention was a whole-school design (Pate et al., 2005), which is difficult for schools to maintain. Also, determining which components of the SEM may have affected the change was difficult. Unfortunately, both intervention studies measured PA via self-report (Hortz & Petosa, 2006; Pate et al., 2005), which can be unreliable due to social desirability and recall bias (Troost, 2007; Warren et al., 2010). Schools are identified as prime target settings for the promotion of PA (CDC, 2017; WHO, 2020) because of the broad influence on adolescents who are required to attend school; however, due to rigorous academic requirements, many rural HS students are unable to take PE or health education every day, and an in-school approach may not be feasible in all districts (Love et al., 2019). Moreover, while altering curricula during the school day to increase PA may be successful for short-term gains, a long-term change has not been demonstrated consistently (Love et al., 2019). Therefore, conducting interventions outside the school day to increase HS students' PA is recommended.

After-school interventions. After-school provides an ideal setting for PA interventions, as previous after-school PA interventions have resulted in a moderate-effect on PA (SMD=.44; Beets et al., 2009; Heath et al., 2012). However, only one after-school intervention was found that included HS age students, but was not with a rural population. Lubans and Morgan's (2008) 8-week extracurricular SCT sport program had a significant effect only on adolescents classified as low-active at baseline, but not on those classified as active. Unfortunately, the low-active participants still did not meet the step recommendation, which may limit the clinical significance

of the intervention. Moreover, the intervention did not incorporate technology, which is a suggested approach for HS students (Loescheer et al., 2018).

Barriers to scientific progress in PA interventions for HS students to date. Although PA interventions have been tested among urban HS students, the approaches and related findings cannot be generalized to rural HS students, due to differences in their physical environment (e.g., limited access to PA opportunities or increased distance to facilities; Barnidge et al., 2013; Cleland et al., 2015). Another issue is that the approaches lack the use of autonomy-supportive PA environments in the after-school setting for HS students to assist them with increasing their PA. An autonomy-supportive environment may help adolescents meet their BPNs of relatedness, competence, and autonomy as a means to increase their autonomous motivation for PA (Standage, Duda, & Ntoumanis, 2005). However, no studies were found that tested the effect of an autonomy-supportive environment on the PA of rural HS students in an after-school setting.

Demographic variables. Identifying demographic factors that can potentially influence adolescents' participation in PA interventions is essential for developing effective PA interventions. Several demographic factors, such as age, race, sex, SES, and prior behavior, affect whether U.S. adolescents meet PA guidelines. There are gaps in PA and related opportunities for PA based on these demographic variables that need to be addressed.

Age. Adolescents aged 16-19 only achieve 26 minutes of MVPA, whereas as adolescents aged 12-15 achieve 33 minutes of MVPA (Belcher et al., 2010). However, children aged 6-11 participate in even more PA (88 minutes; Belcher et al., 2010). Only 6% of HS-age adolescents are required to take physical education (PE) classes at least 3 days per week, as compared to 15% of elementary age students (School Health Policies and Practices Study, 2014); in addition, these adolescents can obtain PE class exemption waivers. A significant drop in PA occurs with

advancing age (National PA Plan Alliance, 2018). Decreases in PA are steeper from ages 12-17 than ages 18-24; this occurrence may be due to decreases in the amount of PA required when reaching early adulthood (Armstrong et al., 2018). For example, U.S. recommendations call for adults to achieve 150 minutes of PA per week (CDC, 2018). However, the notable decrease in PA across adolescence may be due to increased demands on adolescents' time (e.g., increased schoolwork, employment; Armstrong et al., 2018). Regardless, intervention strategies that can decrease the stark decline in PA are needed.

Race. Differences in race related to PA are somewhat unclear for adolescents and not always consistent across data sets (National PA Plan Alliance, 2018). Accelerometer data for 6- to 19-year-olds show Non-Hispanic White youth to be the least active (21.1%; Troiano et al., 2008). This dissertation work will be completed in a rural area that has a high level of Non-Hispanic White youth (MiPHY, 2018). However, YRBS data show (2017) 48.7% of non-Hispanic white youth engage in at least 60 minutes of PA daily, which is higher than African American and Hispanic youth in this self-report data.

Sex. Regardless of data sources, boys are more active than girls, however these differences are greatest in younger children than adolescents (National PA Plan Alliance, 2018). Youth Risk and Behavior Survey data (2017) show that approximately 18% of HS-age girls and 35% of HS-age boys report participating in at least 60 minutes of daily PA. Accelerometer data also show that 28% of boys and 20% of girls ages 6-17 engage in at least 60 minutes of PA daily (National PA Plan Alliance, 2018). Findings that females attain less PA than males persist across all race/ethnicity and income groups (Armstrong et al., 2018) making this an important variable to examine.

SES. Armstrong et al. (2018) found that low-income adolescents in all groups (sex, racial/ethnicity, age) reported less PA than their higher income peers; other studies have also associated lower SES with lower PA level (Boone-Heinonen et al., 2010; Gordon-Larsen et al., 2006). Those with lower SES have less money to spend on sports participation fees, are unable to pay the high fees for PA opportunities, and typically the built environment around them has few safe parks, sidewalks, and facilities to participate in PA (Armstrong et al., 2018). Stalsberg and Pederson (2018) recommend that SES should always be considered when working with PA domains. Stalsberg and Pederson (2018) reviewed 56 studies and noted that the only domain having a positive relationship with leisure time PA was SES (Stalsberg & Pederson, 2018); making SES an important variable to include in studies.

Prior Behavior. Among adolescents aged 10-13 years old, those with higher levels of PA had less decline in PA over time (Craggs et al., 2011). In a systematic review (Craggs et al., 2011) of 46 studies, 31 used self-report of PA and included children and adolescents between the ages of 4-18. Results showed that adolescents with higher levels of PA had less of a decline in PA with advancing age. PA in adolescence improves physical fitness, cardiometabolic health, bone health, cognitive outcomes, and mental health, and reduces adiposity (WHO, 2020). Assessing adolescents' prior PA level as a variable in intervention studies is important.

Secondary Outcomes. *Sedentary behavior* is typically higher in adolescents who are not meeting MVPA requirements (Barnett et al., 2018). Physical inactivity and high sedentary behavior are global public health concerns. Sedentary behavior has distinct negative health outcomes, such as cardiovascular disease, cancer, and Type II diabetes, in adults (Biswas et al., 2015). According to Common Sense Media (2020), the average amount of time per day that adolescents (13-to-18 years old) use recreational screen time-based media is 6 hours 40 minutes

(Rideout & Robb, 2019) which is considered sedentary behavior. In addition, screen time-based media increases substantially with age, most notably during preadolescence, leading to adolescents being the most sedentary of the pediatric populations and engaging in the most screen time-based media daily (Barnett et al., 2018). Most guidelines indicate that less than 2 hours of screen-time is recommended for the adolescent population (Barnett et al., 2018). Screens are becoming more and more embedded in adolescents' lives; and although increased exposure may seem inevitable, encouraging adolescents to move more and have less sedentary behavior is important.

Perceived Stress. Perceived stress arising from life events and daily hassles can have a negative outcome on adolescents' health. To cope effectively with stress, adolescents appraise both the degree of threat involved and whether they have the resources to deal with the stress (Lazarus & Folkman, 1984). In the American Psychological Association (2018) survey to assess stress among people in the U.S., adolescents reported higher levels of stress than adults, worse mental health, and higher levels of anxiety and depression than any age group. For adolescents, stress can have an impact on a variety of healthy behaviors like sleep, eating, and PA. Helping adolescents understand how to manage their stress in a positive way with healthy habits, like PA, getting enough sleep, and good nutritional habits, is important. Although adolescents report higher levels of stress than adults, they do not report seeing the connection between stress and negative health outcomes and the impact that stress can have on their health (APA, 2018). To break the cycle of stress and unhealthy behaviors, it is important for adolescents to have the support they need to cope with their stress. PA is a positive coping strategy that can help adolescents manage their stress.

%BF and BMI. Studies have shown that PA interventions can improve physical or cardiorespiratory fitness, and as a result, decrease BMI and % BF (Vasconcellos et al., 2014). Both BMI and %BF will be used to determine overweight or obesity status of the students.

Self-report PA. Participants will also complete a self-report measure of PA at the end of the intervention period. Self-report is a common method of assessment for PA data and will allow for a back-up method of analysis if incomplete data via the ActiGraph is received from participants (Sylvia et al., 2014).

Critical need for effective after-school PA interventions for rural HS students. One approach, currently being promoted, that has not been used in any after-school interventions including HS students involves developing an autonomy-supportive PA environment to help increase adolescents' autonomous motivation for PA (Aelterman et al., 2016; De Meester et al., 2017; Kerner & Goodyear, 2017). Autonomy-supportive PA environments are those that: (1) provide adolescents with options related to PA so that they can choose what they want to engage in (autonomy), (2) help adolescents to develop skills so that they can feel successful when engaging in PA (competence), and (3) assist adolescents in building quality relationships with others who can support their PA (relatedness; see Figure 1.1).

Interventions that capitalize on recent technological advances through electronic delivery are also a promising approach for adolescents. This delivery method is appealing to HS students because of their strong interest in and regular use of technology (Rideout & Robb, 2019). Approximately 95% of adolescents have a smartphone, and this percentage is consistent across geography, races, ethnicities, and SES (Rideout & Robb, 2019). A recent systematic review (Loescheer et al., 2018) showed that text messages had the potential to improve healthy lifestyle behavior. Two studies including HS students were found that tested a technology-based

intervention to increase PA. One intervention using text messages to improve adolescent PA (ages 12-15 years old; Lau et al., 2012) had a significant effect in increasing self-reported PA. Using an objective measure of PA in future intervention studies can provide a valid, accurate, and reliable measure of PA related to technology-based interventions (Prince et al., 2008). The other text messaging intervention (Thompson et al., 2016) for healthy adolescents' (ages 14-17) focused on increasing pedometer steps and resulted in an improvement in MVPA of 1.73 minutes per day when measured via accelerometer. The limited clinical effect in Thompson et al. (2016) pilot study may indicate a need for additional types of delivery modes and options related to PA besides only pedometer steps to allow for the adolescent to have autonomy and choice. Both studies were theory based, with one applying the SDT (Thompson et al., 2016) and the other using the Trans-theoretical Model (Lau et al., 2012) respectively. A meta-analysis (Webb et al., 2010) on health behavior change and mode of delivery suggested that greater use of supplemental modes (like text messages, avatars) could strengthen the intervention effect. Therefore, combining two face-to-face after-school autonomy-supportive PA events with theory-based avatar messages in an intervention may lead to a clinically significant improvement in objectively measured MVPA.

Another approach used to improve health outcomes with technology, is the use of avatars. Minjin, Jang and Peng's (2020) systematic review on health interventions using avatars to enhance healthy behaviors (specifically healthy eating and PA) included 18 studies; the results of the review showed that using an avatar that is physically active, fit, and similar looking to the user is an effective way to improve health behavior. Avatars are graphical representation of users in a variety of electronic environments (Biocca, 1997; Minjin, Jang, & Peng, 2020). Of the 18 studies, only one study had a population of children (ages 9-12 years old; overweight; Li, Lwin,

& Jung, 2014), but 15 had college-age participants – the latter of whom may be more associated with the HS population (Minjin, Jang, & Peng, 2020). These 15 studies were laboratory experiments that typically provided brief single exposure to the avatar (Minjin, Jang, & Peng, 2020). None of the studies used avatars to represent a peer to motivate participants to increase their PA (Minjin, Jang & Peng, 2020). An avatar, especially a peer avatar, can serve as a model of behavior through observation and imitation (Minjin, Jang, & Peng, 2020).

Based on evidence indicating that peer support for PA is important (Fritgerald et al., 2012; Macdonald-Wallis et al., 2012) and that peer relatedness can strengthen an autonomy-supportive environment (Gillison et al., 2013; Jõesaar et al., 2012) avatars representing a peer will be used to deliver SDT motivational messages to increase HS student's autonomous motivation for PA. This approach makes sense because autonomous motivation for PA improves when the basic psychological needs (BPNs) improve, and increased autonomous motivation has been linked to long-term behavior change (Owen et al., 2014).

Conceptual Framework

A detailed discussion of the SDT will be provided, and the model will be depicted. Then, the adapted conceptual model, followed by the operational model guiding this dissertation, will be comprehensively described.

Conceptual Model. SDT has been applied extensively in research aimed at understanding motivation for PA among adolescents (Teixeira et al., 2013) and has been used to guide PA interventions (Fortier et al., 2012). Accumulating evidence supports those interventions addressing all components of the SDT, including all three BPNs, have the potential for improving intended outcomes (Teixeira et al., 2013). An autonomy-supportive environment is consistently identified as being important for improving the BPNs and motivating adolescents to

increase their PA (Standage, Duda, & Ntoumanis, 2005). Supporting the use of this type of environment in SDT-based interventions, a recent meta-analysis that included interventions in the health promotion and disease management literature (all ages and behaviors) showed significant positive changes in need support; competence; autonomy; combined need satisfaction; and autonomous motivation (Ntoumanis et al., 2020). The effect size (I^2) for health behavior at the end of the SDT based interventions was 85.6% (Ntoumanis et al., 2020). This information indicates that SDT is well-suited for designing a peer-based PA text messaging component in an intervention for adolescents because peers can help to create a social climate that can either support an adolescent's BPNs, autonomous motivation for PA, and PA or undermine these areas (Martin, Nigg, & Smith, 2013). Moreover, research on increasing PA levels of rural, HS students is sparse (Beck et al., 2019), indicating the importance of conducting interventions with this at-risk population.

Autonomy-supportive environment. The SDT describes an autonomy-supportive environment as a social context that facilitates the process of increasing autonomous motivation through developing the BPNs of competence, autonomy, and relatedness as related to a specific behavior (Deci & Ryan, 2000).

Basic Psychological Needs. Deci and Ryan (2000) describe the BPNs, including competence, autonomy, and relatedness, as building blocks that influence autonomous motivation. *Competence* is the experience of mastery over a behavior; *autonomy* is a sense of choice and endorsement of the behavior; and *relatedness* is feeling a social connection with others during the behavior (Deci & Ryan, 2000).

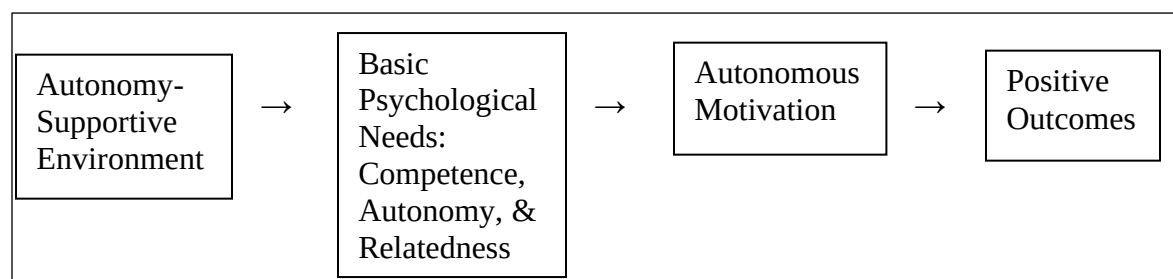
Autonomous Motivation. Ryan and Deci (2017) conceptually define autonomous motivation as motivation that comes from intrinsic sources, as well as extrinsic sources that

involve the individual identifying with the value of the activity and how it aligns with the sense of self. SDT indicates that engaging in behavior because it is consistent with intrinsic goals and outcomes and emanates from the self reflects autonomous motivation (Deci & Ryan, 2000).

Positive Outcomes. The SDT emphasizes that autonomous motivation leads to positive changes in behavior and outcomes (e.g., well-being and growth; Deci & Ryan, 2000).

Model relationships. SDT proposes that an autonomy-supportive environment helps to meet the BPNs of competence, autonomy, and relatedness. When these BPNs are supported autonomous motivation increase and positive outcomes occur (Deci & Ryan, 2000). For example, by providing a variety of autonomy-supportive environments related to PA, such as at home, during sports participation and through the school, students develop competence for PA, autonomy related to PA, and relatedness in PA. Increases in these BPNs then result in enhanced autonomous motivation for PA that, in turn, leads to the positive outcome of PA (see Figure 1.1).

Figure 1.1: Self-determination Theory Conceptual Model



Limitations. The SDT has a few limitations. Unfortunately, most of the research on PA based on this theory has been cross-sectional (Beets et al. 2007; Gray et al., 2008; MacKey and La Greca, 2007; Sallis et al., 2002). Experimental studies are needed to advance the science by rigorously testing this theory. This research serves to address this gap by utilizing an experimental design. Another issue involves the need to continue to develop and test instruments for measuring the theoretical constructs to identify those having the highest levels of validity and reliability. In

many prior studies that tested the theory, PA was assessed via self-report, which has been found to be problematic due to recall and response bias (Trost, 2007; Warren et al., 2010). The current study addresses this issue by using an objective measure of PA.

Information is lacking on whether a theory-based autonomy-supportive PA environment with daily peer delivered avatar motivational messages and weekly PA goals and strategies can impact PA levels in rural, adolescents of HS age. This study is the first to use electronic SDT-based, peer-delivered avatar motivational messages plus weekly PA goals and PA strategies in combination with two after-school events (reflecting an autonomy-supportive environment) to increase MVPA among rural, HS students. Capitalizing on research demonstrating the importance of focusing on the BPNs, particularly peer relatedness (Saez et al., 2018; Sebire et al., 2018), a novel, fun, and engaging way for HS students to increase their MVPA has been developed. This theory-based approach includes an autonomy-supportive environment uniquely designed to meet HS students' BPNs to directly increase their autonomous motivation for PA. Whether autonomous motivation for PA can be increased through an autonomy-supportive PA environment and then lead to increased MVPA among rural, adolescents is basically unknown. Gaps in knowledge related to adolescents of HS age, particularly those living in rural areas, and their PA are evident. The limited research conducted with this population is a major concern because a sharp decline in MVPA occurs with increasing age across adolescence, clearly indicating that this developmental period is a prime time for implementing interventions (Oluwasanu & Oladepo, 2017; Reinehr, 2018). Assisting adolescents to attain adequate PA is essential because increased levels of PA have been associated with improvements in BMI and %BF, and reductions in sedentary behavior and stress in this population.

Recognizing the urgent need to intervene with HS students, researchers have developed and tested PA interventions focusing on physical education (PE) and school environmental change (e.g., increasing MVPA during PE and active classrooms; Babic et al., 2016; Ha et al. 2017; Kerner & Goodyear, 2017; Lonsdale et al. 2013; Nation-Granger, 2017; Perlman, 2013). Unfortunately, these prior school-based interventions resulted in either no or minimal improvement in MVPA and its maintenance. One plausible reason is that the approaches failed to assist HS students in increasing their autonomous motivation for PA. One barrier to implementation is that these interventions require intensive resources and time in an already full academic schedule. Utilizing the time after school rather than during school to assist adolescents to increase their MVPA, may potentially be less resource-intensive and more feasible for improving adolescent autonomous motivation for PA and the behavior itself.

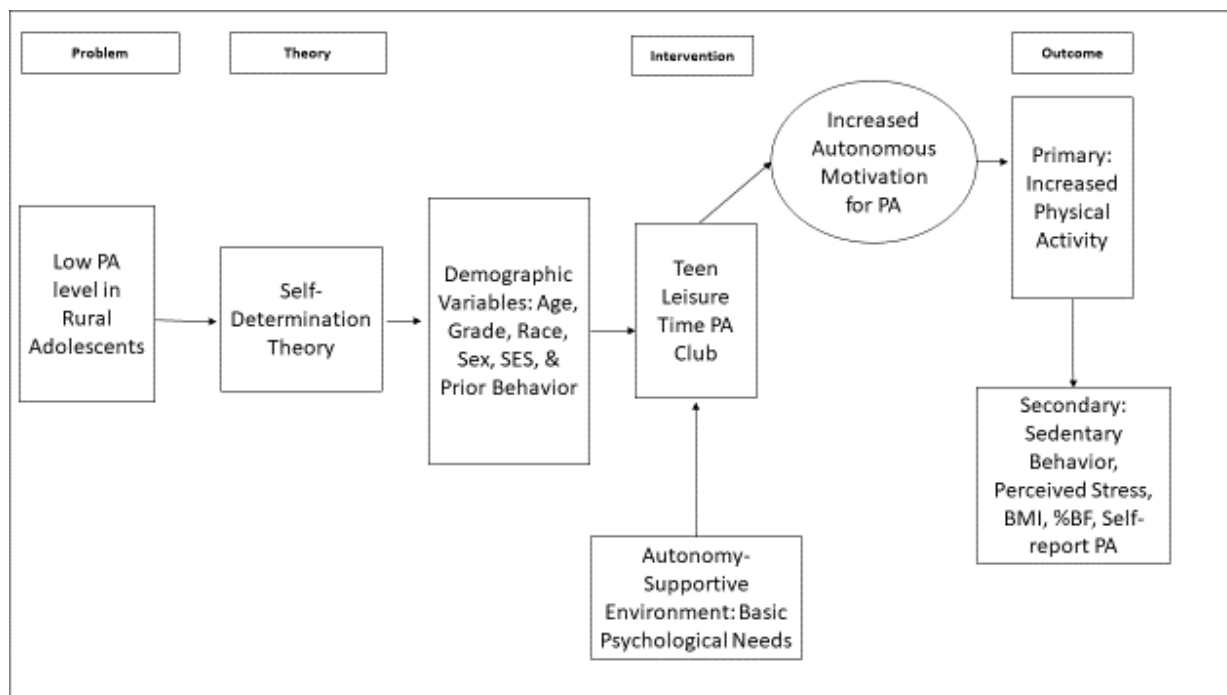
Strengths. The SDT has several strengths. A notable strength of this theory is that the constructs are clear and modifiable and can be targeted in interventions. For example, participating in an autonomy-supportive environment has been found to improve the BPNs of autonomy, competence, and relatedness (Teixeira et al., 2013). SDT has been applied extensively in research aimed at understanding motivation for PA among adolescents (Teixeira et al., 2013) and has been used effectively to guide PA interventions (Fortier et al., 2012).

Synthesize theoretical model, accounting for any modifications.

The original SDT model will be adapted for this dissertation work (see Figure 1.2). This adapted version of the SDT will be used to guide the intervention. It includes adolescent demographic variables or characteristics (age, grade, race, SES, and prior behavior) that may influence rural, adolescents' perceptions (autonomous motivation for PA, BPNs, and autonomy-supportive environment) and behaviors (MVPA, and sedentary behavior) under investigation.

Objectively measured MVPA is the primary outcome. Secondary outcomes include sedentary behavior, BMI, % BF, and perceived stress. Additionally, the model illustrates the following key element from the SDT that is important to include in an intervention to address the previously noted gaps in the literature: the need for an autonomy-supportive PA environment. This environment will be created for rural, adolescents, through two components as follows: an after-school environment and technology-based intervention. The two components of the TLC will be implemented to address all BPNs as a means to increase adolescent autonomous motivation for PA and, in turn directly improve the behavior.

Figure 1.2: Teen Leisure Time Activity Club



Demographic variables will include age (Belcher et al. 2010), grade (Belcher et al., 2010), race (Belcher et al., 2010), socioeconomic status (Stalsberg & Pedersen, 2010), and prior PA level (McMurray et al., 2012; Schreier & Chen, 2013). Except for prior PA level, none of the variables

related to personal factors are directly amenable to intervention. However, all these demographic variables can influence PA (McMurray et al., 2012; Schreier & Chen, 2013).

Constructs from the original model will be the autonomy-supportive environment, BPNs (competence, autonomy, and relatedness), and autonomous motivation but with a focus on PA in each of the components. These constructs are defined as follows:

Autonomy-supportive PA environment is defined as a setting in which individuals feel they are in control of their PA and can make choices surrounding their PA, have a personal connection to others (Alali et al., 2020), and can make choices surrounding their PA; behavior mainly occurs to meet intrinsic goals developed by the self (Aelterman et al., 2016; De Meester et al., 2017; Gillison et al., 2014; Kerner & Goodyear, 2017). The social environment can support or hinder autonomous motivation for PA among adolescents (Aelterman et al., 2016; De Meester et al., 2017; Gillison et al., 2014; Kerner & Goodyear, 2017). Aelterman et al., (2016) found that autonomy-supportive PA environments yielded the most desirable outcomes with the highest levels of learning and performance and the lowest levels of resentment.

BPNs of PA. An environment that provides support for the BPNs of autonomy, competence, and relatedness has the potential to increase autonomous motivation (Gillison et al., 2009; Mouratidis & Michou, 2011; Schneider & Kwan, 2013). Peers, parents, PE teachers, coaches, and other adults or youth role models can help to support the adolescents' BPNs (Gillison et al., 2013; Jõesaar et al., 2012), yet ways to best accomplish this task with rural adolescents continues to remain elusive.

Competence for PA. Competence is the need to gain mastery of PA tasks and learn different PA skills. The autonomy-supportive environment that the adolescent is participating in can contribute to the competence an adolescent may feel regarding the PA. Peers, coaches, and

parents can contribute to an adolescent feeling more competent in his or her PA through verbal encouragement and role modeling behavior (Fullmer et al., 2018; Gillison et al., 2011).

Adolescents will be motivated for PA if they feel they can be successful at the task; without this component being present, they will feel as if they cannot even start the task (Fullmer et al., 2018; Gillison, et al., 2011). Ensuring that PA begins with easier skills, and then advances to more difficult skills, will help support the development of competence towards PA, which in turn, supports autonomous motivation. Competency with skills can be developed through observation as well as active involvement in the skills (Shen, 2014). A lab-based study with adolescents (N=192; ages 14-16) showed a correlation of .51 to .66 between perceived competence and autonomous motivation to exercise (Schneider, & Kwan, 2013). A systematic review (Craggs et al., 2011) showed that adolescents PA decreased less in adolescents (aged 14-18; 46 studies included) with higher perceived self-efficacy. An additional review of reviews demonstrated that perceptions of competency is an important correlate of PA in adolescents (Biddle et al., 2011). This review included nine systematic reviews completed between 2000-2010, that involved children and adolescents (Biddle et al., 2011).

PA Autonomy. PA autonomy among adolescents is identified as their basic need to experience behavior as volitional (Fullmer et al., 2018; Palmer et al., 2020). Adolescence is an important time of growth and development during which adolescents crave peer acceptance and seek opportunities to develop autonomy and independence from parents/guardians (Healthy People, 2020; Jarvis, 2019). Adolescents need to feel they have a choice in behaviors they participate in (Fullmer et al., 2018; Nicaise & Kahan, 2013). Schneider and Kwan's (2013) study showed a significant correlation of .19 to .29 ($p < .003$) between perceived PA autonomy and

autonomous motivation for PA. Cragg's et al. (2011) systematic review showed there was less decline in PA when adolescents had higher perceived behavioral control.

Relatedness in PA. Relatedness in PA is the need to experience a sense of belonging and attachment to other people during PA. Developing a sense of relatedness is another important part of an autonomy-supportive PA environment to enhance autonomous motivation for PA (Fullmer et al., 2018; Gillison et al., 2011). Adolescents are seeking new identities that support their own interests and want to feel that they belong with others who share in those same interests. Results from previous studies related to social support have indicated a need for continued research on social support as a predictor of PA among adolescents in order to specifically identify the type of social support needed to increase their PA (Draper et al., 2015; Laird et al., 2016; Mendonca et al., 2014). Participation in youth sports and organized clubs can also influence adolescent PA in a positive way when an autonomy-supportive PA environment is present (Li et al., 2014). Schneider and Kwan's (2013) reported a correlation of .25 to .42 between perceived relatedness and autonomous motivation for PA. Cragg's et al. (2011) systematic review showed there was less decline in PA when adolescents had support for PA as well.

Autonomous motivation for PA. Adolescent autonomous motivation for PA is a personal desire to attain PA because the behavior is fun and enjoyable, or it is an important part of how the adolescent self-identifies (Palmer et al., 2020). In a meta-analysis, Owen et al. (2014) demonstrated that autonomous motivation for PA had a positive association with PA ($r = .21-.31$). In a systematic review focused on 5-to-19-year-olds who were not attaining adequate MVPA, Yew et al. (Yew et al., 2013) underscored the need for environmental support and a theoretical approach to increase autonomous motivation. A recent cross-sectional study indicated

that peers' autonomy supportive behavior can improve the BPNs, autonomous motivation, and MVPA in 12-to-15-year-old adolescents (Tilga et al., 2019). Although these results were promising, no studies were found that tested the effect of an intervention on increasing peers' autonomy supportive behavior to improve rural HS students' MVPA.

Primary outcome MVPA is a category of activity intensity that requires heavy breathing with exercise (Evenson et al., 2008) and accelerations in an ActiGraph with pre-established cut points of MVPA $\geq 2,296$ counts/minute (Evenson et al., 2008). Increasing adolescents' MVPA has been associated with improvements in their sedentary behavior (McMurray et al., 2012; Schreier & Chen, 2013), BMI (Lohman et al., 2006), % BF (Lohman et al., 2006), and perceived stress (Stults-Kolehmainen & Sinha, 2014).

Secondary outcomes will include sedentary behavior, perceived stress, BMI, % BF, and self-report PA. HS students who are not meeting the recommended levels of MVPA (≥ 60 min/day of mostly MVPA) usually have high sedentary behavior (Must & Tybor, 2005). Increasing rural, HS students' MVPA and reducing their sedentary behavior is critical for increasing the brain's resistance to stress (Ratey & Hagerman, 2008). Studies have shown that PA interventions can improve physical fitness, and as a result decrease BMI and % BF (Vasconcellos et al., 2014). Both BMI and %BF will be used to determine overweight or obesity status of the rural HS students.

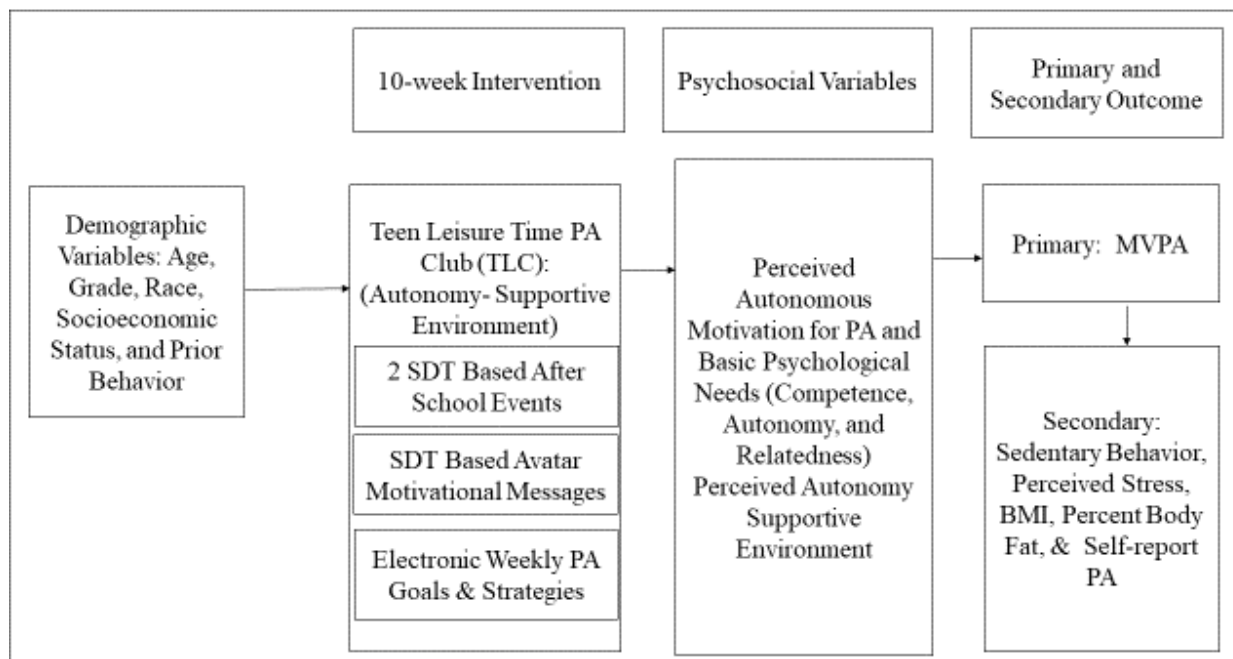
Model relationships. The adapted model depicts a direct relationship between the demographic variables and the intervention. The TLC intervention through increasing perceptions of an autonomy-supportive environment will support the development of the BPNs (competence, autonomy, and relatedness). Through support of the BPNs, the participants will have enhanced autonomous motivation for PA, which will then increase the primary outcome of

PA, and the secondary outcomes of sedentary behavior, perceived stress, BMI, %BF, and self-report PA. This study will then qualitatively examine the participants' and instructors' perceptions of the intervention, including the autonomy-supportive environment.

Operational SDT Model

The operational model (see Figure 1.3) now describes the previous concepts as variables with their measurement parameters to be tested.

Figure 1.3: Operational Model



The operational model first includes the demographic variables that will be used to assess the participants. (Tables 1.1 & 1.2, provide information on the measures.)

Demographic variables (age, grade, race, socioeconomic status, and prior behavior) will be collected from students via an investigator-developed questionnaire sent electronically to students in a Qualtrics survey at baseline.

Autonomous motivation for PA will be assessed with the Behavior Regulation in Exercise Questionnaire-3 (Markland & Tobin, 2004; Wilson et al., 2006). This questionnaire consists of

24 questions with a five-point Likert scale which ranges from 0 (strongly disagree) to 4 (strongly agree). The BREQ-3 has been reported to be valid and reliable (Markland & Tobin, 2004; Wilson et al., 2006) and measures the regulation of exercise behavior based on Ryan and Deci's (2006 & 2017) motivation continuum. Responses are scored based on an item aggregation approach. Intrinsic, integrated, and identified regulation subscales will be averaged into three unique scores. Intrinsic, integrated, and identified regulation are forms of autonomous motivation (Palmer et al., 2020).

Autonomy-supportive environments will be measured via the PASSES (Perceived Autonomy Support Scale for Exercise Settings). PASSES will be used to measure the perception of autonomy support in terms of the instructors at the two face-to-face events. Passes was developed by Hagger et al. (2007). Its 12 items are scored on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Validity has been assessed with young people in exercise settings using confirmatory factor analysis, support from three different persons, and with young people from different cultures (Hagger et al., 2007).

BPNs will be assessed using the Basic Psychological Needs (BPNs) in Exercise Scale that measures perceptions of competence, autonomy, and relatedness (Vlachopoulos et al., 2010). The scale consists of 12 items: 4 items for each need (competence, autonomy, and relatedness). The items are scored on a five-point Likert scale ranging from 1 (I do not agree at all) to 5 (I completely agree).

Primary Outcome of MVPA (min/hr.) will be measured with ActiGraph GT3X-plus accelerometers with pre-established cut points of MVPA $\geq 2,296$ counts/min (Evenson et al., 2008). Data will be excluded if the ActiGraph is taken off during hours awake (noted by 20 or more consecutive minutes of continuous zeros; Treuth et al., 2003).

Secondary Outcomes. Sedentary behavior will be tracked with ActiGraph GT3X-plus accelerometers. The pre-established cut point for sedentary PA is ≤ 100 counts/min (Trost et al., 2011). Perceived stress will be measured with the valid 10-item Perceived Stress Tool (ages 13-17) NIH (Kupst et al., 2015). This scale will provide a self-appraisal of how the student feels related to stress over the past month. BMI will be calculated from weight and height (kg/meters²) using Centers for Disease Control and Prevention Growth Charts (Kuczmarski et al. 2000). Percent BF will be estimated with the Tanita Scale (bioimpedance; BC-534). Self-report of PA will be completed with the Physical Activity Questionnaire – Adolescent (PAQ-A; nine questions long; Kowalski et al., 1997).

Feasibility will be measured by (a) enrollment rates: proportion of invited students who enroll; (b) attrition rates: proportion of students who stop participation; and (c) attendance rates: proportion of students who attend the two PA club events and deliver/receive daily avatar messages and weekly goals/strategies messages. Instructors' satisfaction with the PA club will be evaluated using investigator-developed questions. Participant satisfaction will be assessed after the intervention using student-completed surveys and six to 10 individual interviews (45 min each) with randomly selected students (conducted by phone, audio-recorded, and transcribed verbatim). The club instructors' ability to maintain an autonomy-supportive environment will be evaluated by the PI prior to the club (Protocol Check-off in Appendix,). The PI will provide retraining as needed.

Purpose

The **purpose** of this pilot study is to test the feasibility and preliminary efficacy of a 10-week TLC intervention in increasing MVPA, decreasing sedentary behavior, decreasing perceived stress, decreasing BMI, decreasing %BF, and improving autonomous motivation for

PA and the BPNs (variables related to PA); among rural, HS students. For this study, both quantitative and qualitative data will be collected. The main study involves a pretest (Wk 0: baseline) - posttest (Wk 11: post-intervention) quasi-experimental design. The study utilized a convenience sample from the two willing HSs (grades 9-12) to receive either the TLC intervention or a control condition (usual school activities). After the intervention ends, up to 10 individual interviews will be conducted with randomly selected willing participants. These semi-structured telephone interviews will occur with intervention participants to explore their experiences. It is anticipated that using both quantitative and qualitative methodology will provide a more comprehensive examination and a broader understanding of the feasibility and effect of the intervention than using only one method (Tariq & Woodman, 2013). The quantitative component of this study will focus on improving the primary outcome of MVPA (min/hr., accelerometer-measured) and secondary outcomes (sedentary behavior, perceived stress, BMI, % BF, perceived stress, and self-report PA) and increasing the variables related to PA (autonomous motivation; BPNs [competence, autonomy, and relatedness], autonomy-supportive environment).

Dissertation Format

This dissertation adheres to a multiple manuscript approach. The introduction in Chapter 1 is followed by Chapters 2, 3, and 4, which include Manuscripts 1, 2, and 3, respectively. Chapter 5 of this dissertation provides a synthesis of findings, recommendations for future work, and conclusions. Each manuscript will address the research questions within the three aims of this proposed dissertation.

Manuscript One (Concept Analysis)

Chapter two is a concept analysis of adolescent autonomous motivation of PA. The paper presents the state of the science on the concept which is paramount in the proposed intervention study. It describes how the concept is measured, and how it has been used in the past.

The research questions for this concept analysis are:

1. What is the state of the science regarding adolescent autonomous motivation for PA?
2. How is adolescent autonomous motivation for PA measured?

Additionally, the review frames the literature with an assessment of the conceptual foundations of adolescent autonomous motivation for PA using the SDT. The paper is published in the Journal of Pediatric Nursing.

Dissertation Aim 1 (DA1)

Analyze the concept of adolescent autonomous motivation for PA. A modified version of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram (Moher, Liberati, & Altman, 2009) was used to guide the review for the concept analysis of adolescent autonomous motivation of PA. The paper titled “Adolescent autonomous motivation for PA: A concept analysis” (Palmer, et al., 2020) utilized Rodger’s Evaluation Method (2000) of concept analysis. The purpose of this manuscript was to present an analysis of the concept of adolescent autonomous motivation for PA by identifying its defining attributes, related concepts/surrogate terms, antecedents, and consequences. To build on the current, but limited, understanding of adolescent autonomous motivation for PA, the manuscript provided a conceptual definition formulated from a comprehensive review and integration of the theoretical and empirical literature. A literature review related to adolescent autonomous motivation for PA was completed utilizing the following databases: Cumulative Index of Nursing and Allied Health

Literature (CINAHL), Education Resources Information Center (ERIC), PsychINFO, PubMed and SPORT Discus. Key words used for the review were motivation, autonomous motivation, adolescents or teenagers or young adults and PA or exercise or fitness or physical exercise. The analysis indicated that adolescent autonomous motivation for PA is reflected by a continuum and is dynamic (DeMeester et al., 2017; Dishman et al., 2018; Wang, 2017). Adolescent autonomous motivation for PA may include intrinsic motivation and the following two forms of extrinsic motivation: integrated and identified regulations. The level of adolescent autonomous motivation for PA is based on the social context and autonomy-supportive environment providing support for or hindering its development (Fullmer et al., 2018; Gillison et al., 2011). Positive perceptions of PA impact autonomous motivation for PA. As related to the purpose of this study, the theory indicates that assisting rural HS students to meet their BPNs in an autonomy-supportive environment may increase their autonomous motivation for PA, and, in turn, the behavior itself.

Manuscript Two/Chapter Three (Quantitative Study)

Manuscript two reports on an original quantitative study using a pretest-posttest design to test the effect of an intervention, called TLC, on Rural, HS Students' PA. HS students (N= 31) will participate in the 10-week TLC that includes two face-to-face after-school events, daily motivational text messages, and weekly PA goals and strategies; or they will participate in usual after-school activities control condition.

The research questions for Chapter 3 are:

1) What is the effect of the 10-week TLC intervention as compared to the control on rural, MVPA (primary outcome) or the secondary outcomes (e.g., sedentary behavior, perceived stress, BMI, %BF, and self-report PA)?

2) What is the feasibility of the 10-week TLC intervention for rural, adolescents?

Students were recruited from two rural communities through the identified HSs and asked to participate in the study.

Dissertation Aim 2 (DA2)

To test the preliminary efficacy of a 10-week TLC intervention among rural, HS students, as compared to a control condition, on: a) increasing MVPA (primary outcome; min/hr.; accelerometer-measured); decreasing sedentary behavior, perceived stress, BMI, % BF; and increasing self-reported PA; and b) and improving psychosocial (BPNs: competence, autonomy, and relatedness and autonomous motivation for PA; Manuscript 2). Evaluate the feasibility of the intervention related to: HS students' enrollment, attrition, and attendance in the club; delivery/receipt of avatar motivational messages and weekly PA goals and strategies; and adherence to protocols (Manuscript 2).

Manuscript two reports on an original quantitative study using a pretest-posttest design (Wk. 0: baseline; Wk. 11: post-intervention) to test the effect of an intervention, called TLC, on rural HS students' PA. HS students (N= 31) will participate in the 10-week TLC that includes two face-to-face after-school events, daily motivational text messages, and weekly PA goals and strategies; or they will participate in a usual after-school activities control condition. The primary purpose of the study is to determine whether rural, low-active HS adolescents in the 10-week TLC intervention show greater improvement in MVPA, sedentary behavior, perceived stress, BMI, and %BF than adolescents in the control group. At baseline and post intervention, HS students' complete questionnaires assessing demographics, BPNs, autonomous motivation, perceptions of autonomy-supportive environment, and perceived stress. PA is measured via ActiGraph and self-report, and body composition is estimated (objective measures: BMI [height

and weight]; and %BF). Findings are expected to support testing with a larger sample and provide insight on the potential role of autonomy-supportive environments for increasing the BPNs, autonomous motivation, and MVPA. The effect of the intervention on MVPA will be estimated and used to power a future large-scale RCT and test efficacy. This manuscript will be submitted to Nursing Research.

Manuscript Three/Chapter Four (Qualitative Study)

Manuscript three reports on an original qualitative study using qualitative content analysis (Krippendorff, 2013) related to the participants satisfaction with the PA intervention. Chapter four is a qualitative data analysis of participants in the Teen Leisure Time PA Club for Rural, Adolescents Trial. Participants (N= 10) in the trial were interviewed via Zoom with a semi-structured interview guide.

The research questions for this manuscript are:

- 1) How do rural, adolescents evaluate their experience in an intervention that includes an autonomy-supportive environment to increase PA? And,
- 2) What approaches optimally leverage peer relatedness in promoting adolescent PA?

Dissertation Aim 3 (DA3)

To explore HS students' satisfaction (individual interviews; Manuscript 3).

Manuscript three in Chapter Four reports on an original qualitative study using framework analysis (Glesne, 2011; Starks & Brown Trinidad, 2007; Thompson et al., 2022) to evaluate the TLC by exploring perceptions of rural, low-active HS students who received the intervention. Participants (N=10) will be interviewed via Zoom with a semi-structured interview guide. Ten HS students will be recruited to complete 30-45-minute semi-structured Zoom interviews after completing the intervention. The interviewer will ask the HS students questions

about the autonomy-supportive environment, including the two after-school events and the peer avatar motivational messages, and about ways to improve the intervention. Interviews will be guided by a semi-structure interview guide, recorded, and transcribed verbatim. The interviews will be coded using N-Vivo Software. Major and minor themes will be identified (Glesne, 2011; Starks & Brown Trinidad, 2007; Thompson et al., 2022). The manuscript is formatted for submission to Journal of School Nursing for publication consideration.

Chapter 5

Chapter 5 summarizes dissertation findings and synthesizes conclusions for future implications as they contribute to nursing research, practice, education, and policy.

REFERENCES

- Aelterman, N., Vansteenkiste, M., Soenens, B., & Haerens, L. (2016). A dimensional and person-centered perspective on controlled reasons for non-participation in physical education. *Psychology of Sport Exercise*, 23: 142-154.
- Alali, M. A., Robbins, L. B., Ling, J., Kao, T.-S. A., & Smith, A. L. (2020). Concept analysis of relatedness in physical activity among adolescents. *Journal of Pediatric Nursing*. doi:<https://doi.org/10.1016/j.pedn.2020.06.005>
- Armstrong, S., Wong, C. A., Perrin, E., Page, S., Sibley, L., & Skinner, A. (2018). Association of physical activity with income, race/ethnicity, and sex among adolescents and young adults in the United States: Findings from the National Health and Nutrition Examination Survey, 2007-2016. *JAMA pediatrics*, 172(8), 732–740. <https://doi.org/10.1001/jamapediatrics.2018.1273>
- Barnett, T. A., Kelly, A. S., Young, D. R., Perry, C. K., Pratt, C. A., Edwards, N. M., . . . Vos, M. B. (2018). Sedentary behaviors in today's youth: Approaches to the prevention and management of childhood obesity: A scientific statement from the American Heart Association. *Circulation*, 138(11), e142-e159. doi:[doi:10.1161/CIR.0000000000000591](https://doi.org/10.1161/CIR.0000000000000591)
- Barnidge, E., Radvanyi, C., Duggan, K., Motton, F., Wiggs, I., Baker, E., & Brownson, R. (2013). Understanding and Addressing Barriers to Implementation of Environmental and Policy Interventions to Support Physical Activity and Healthy Eating in Rural Communities. *The Journal of Rural Health*, 29(1), 97-105. doi:[10.1111/j.1748-0361.2012.00431.x](https://doi.org/10.1111/j.1748-0361.2012.00431.x)
- Beck, A., Eyler, A., Aaron Hipp, J., King, A., Tabak, R., Yan, Y., . . . Brownson, R. (2019). A multilevel approach for promoting physical activity in rural communities: A cluster randomized controlled trial. *BMC Public Health*, 19(1), 126. doi:[10.1186/s12889-019-6443-8](https://doi.org/10.1186/s12889-019-6443-8)
- Beets MW, Beighle A, Erwin HE, Huberty JL. (2009). After-school program impact on physical activity and fitness: A meta-analysis. *American Journal of Preventive Medicine*;36(6):527-537. doi:[10.1016/j.amepre.2009.01.033](https://doi.org/10.1016/j.amepre.2009.01.033)
- Belcher, B. R., Berrigan, D., Dodd, K. W., Emken, B. A., Chou, C. P., & Spruijt-Metz, D. (2010). Physical activity in US youth: effect of race/ethnicity, age, gender, and weight status. *Medicine and science in sports and exercise*, 42(12), 2211–2221. <https://doi.org/10.1249/MSS.0b013e3181e1fba9>
- Biddle, S., Atkin, Cavill, N., & Foster, C. (2011). Correlates of physical activity in youth: A review of quantitative systematic reviews. *International Review of Sport and Exercise Psychology*, 4, 25-49. doi:[10.1080/1750984X.2010.548528](https://doi.org/10.1080/1750984X.2010.548528)

- Biocca, F.(1997). The cyborg's dilemma: Progressive embodiment in virtual environments. *Journal of Computer Mediat Communications* 1997; 3:JCMC324.
- Biswas, A., Oh, P., Faulkner, G., Bajaj, R., Silver, M., Mitchell, M., & Alter, D (2015). Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Annals Internal Medicine*;162(2):123-32. doi: 10.7326/M14-1651.
- Boone-Heinonen J, Evenson KR, Song Y, Gordon-Larsen P. (2010). Built and socioeconomic environments: patterning and associations with physical activity in U.S. adolescents. *International Journal of Behavior Nutrition & Physical Activity*;7:45.
- Borde R, Smith JJ, Sutherland R, Nathan N, Lubans DR. (2017). Methodological considerations and impact of school-based interventions on objectively measured physical activity in adolescents: A systematic review and meta-analysis. *Obesity Review*;18, 476–90. 10.1111/obr.12517
- Centers for Disease Control and Prevention. (n.d.). Gateway to health communication & social marketing impact (2017). Retrieved from <https://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/PhysicalInactivity.html>
- Centers for Disease Control and Prevention. Results from the School Health Policies and Practices Study (2014). Atlanta, GA: U.S. Department of Health and Human Services; 2015.
- Cleland, V., Hughes, C., Thornton, L., Squibb, K., Venn, A., & Ball, K. (2015). Environmental barriers and enablers to physical activity participation among rural adults: A qualitative study. *Health Promotion Journal of Australia*, 26(2), 99-104. doi:10.1071/he14115
- Craggs, C., Corder, K., van Sluijs, E. M., & Griffin, S. J. (2011). Determinants of change in physical activity in children and adolescents: a systematic review. *American journal of preventive medicine*, 40(6), 645–658. <https://doi.org/10.1016/j.amepre.2011.02.025>
- De Meester, A., Cardon, G., DeBourdeaudhuij, I., & Haerens, L.(2017). Extracurricular school-based sports as a stepping stone toward an active lifestyle? Differences in physical activity and sports-motivation between extracurricular school-based sports participants and non-participants. *Journal of Teaching in Physical Education* 36(4), 485-497.
- Deci, E., and Ryan, R. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, 49(3). 182-5.
- Dishman, R., McIver, K., Dowda, M., & Pate, R. (2018). Declining physical activity and motivation from middle school to high school. *Medicine & Science in Sports & Exercise*, 50(6), 1206-1215. doi:10.1249/MSS.0000000000001542

- Euler R, Jimenez EY, Sanders S, Kuhlemeier A, Van Horn ML, Cohen D, et al. Rural–Urban Differences in Baseline Dietary Intake and Physical Activity Levels of Adolescents. *Prev Chronic Dis* 2019;16:180200. DOI: <http://dx.doi.org/10.5888/pcd16.180200>
- Evenson, K., Catellier, D., Gill, K., Ondrak, K., & McMurray, R. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sport Sciences* 26(14), 1557-1565. doi: 10.1080/02640410802334196
- Fitzgerald A, Fitzgerald N, Aherne C. (2012). Do peers matter? A review of peer and/or friends' influence on physical activity among American adolescents. *Journal of Adolescents*; 35:941–58. 10.1016/j.adolescence.2012.01.002
- Fortier MS, Duda JL, Guerin E, Teixeira PJ. (2012). Promoting physical activity: development and testing of self-determination theory-based interventions. *International Journal of Behavior Nutrition Physical Activity*;9:20. 10.1186/1479-5868-9-20
- Fullmer, M., Wilkinson, C., Prusak, K., Eggett, D., & Pennington, T. (2018). Adolescent physical activity and motivational profiles while keeping a physical activity record. *Journal of Teaching in Physical Education*, 37(1), 1-11.
- Gillison, F., Standage, M., & Skevington, S. (2011). Motivation and body-related factors as discriminators of change in adolescents' exercise behavior profiles. *Journal of Adolescent Health*, 48(1), 44-51.
- Gillison, F., Standage, M., & Skevington, S. (2013). The effects of manipulating goal content and autonomy support climate on outcomes of a PE fitness class. *Psychology of Sport Exercise*, 14(3), 342-352.
- Gillison, F., Osborn, M., Standage, M., & Skevington, S. (2009). Exploring the experience of introjected regulation for exercise across gender in adolescence. *Psychology of Sport & Exercise*, 10(3), 309-319.
- Glesne, C. (2011). *Becoming qualitative researcher: An introduction*. (4th ed.). Boston, MA: Pearson.
- Gordon-Larsen P, Nelson MC, Page P, Popkin BM. (2006) Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics*, 117(2):417-424
- Healthy People (2020). Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, retrieved from: <https://www.healthypeople.gov/2020/topics-objectives/topic/Adolescent-Health>
- Heath, G. W., Parra, D. C., Sarmiento, O. L., Andersen, L. B., Owen, N., Goenka, S., Montes, F., Brownson, R. C., & Lancet Physical Activity Series Working Group (2012). Evidence-

- based intervention in physical activity: lessons from around the world. *Lancet (London, England)*, 380(9838), 272–281. [https://doi.org/10.1016/S0140-6736\(12\)60816-2](https://doi.org/10.1016/S0140-6736(12)60816-2)
- Hohepa, M., Schofield, G., & Kolt, G. (2004). Adolescent obesity and physical inactivity. *The New Zealand Medical Journal*, 117(1207).
- Hortz, B., & Petosa, R. (2006). Impact of the “Planning to be Active” leisure time physical exercise program on rural high school students, *Journal of Adolescent Health*, 39(4), 530–535. doi.org/10.1016/j.jadohealth.2006.03.015.
- Hruby, A., & Hu, F. B. (2015). The Epidemiology of Obesity: A Big Picture. *Pharmacoeconomics*, 33(7), 673–689. <https://doi.org/10.1007/s40273-014-0243-x>
- Jõesaar, H., Hein, V., & Hagger, M. (2012). Youth athletes' perception of autonomy support from the coach, peer motivational climate and intrinsic motivation in sport setting: One-year effects. *Psychology of Sport Exercise* 13(3): 257-262.
- Johnson, J. A., 3rd, & Johnson, A. M. (2015). Urban-rural differences in childhood and adolescent obesity in the United States: a systematic review and meta-analysis. *Child Obes*, 11(3), 233-241. [doi:10.1089/chi.2014.0085](https://doi.org/10.1089/chi.2014.0085)
- Kerner, C., & Goodyear, V. (2017). The motivational impact of wearable healthy lifestyle technologies: A self-determination perspective on fitbits with adolescents. *American Journal of Health Education*, 48(5), 287-297. [doi: 10.1080/19325037.2017.1343161](https://doi.org/10.1080/19325037.2017.1343161)
- Kupst, M. J., Butt, Z., Stoney, C. M., Griffith, J. W., Salsman, J. M., Folkman, S., & Cella, D. (2015). Assessment of stress and self-efficacy for the NIH Toolbox for Neurological and Behavioral Function. *Anxiety, stress, and coping*, 28(5), 531–544. <https://doi.org/10.1080/10615806.2014.994204>
- Lau, E.Y., Lau, P.W., Chung, P.K., Ransdell, L.B., & Archer, E. (2012). Evaluation of an internet-short message service-based intervention for promoting physical activity in Hong Kong Chinese adolescent school children: A pilot study. *Cyberpsychology Behavior Soc Network*. 15(8):425-434. [doi:10.1089/cyber.2012.0161](https://doi.org/10.1089/cyber.2012.0161)
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.
- Loescher LJ, Rains SA, Kramer SS, Akers C, Moussa R. A Systematic Review of Interventions to Enhance Healthy Lifestyle Behaviors in Adolescents Delivered via Mobile Phone Text Messaging. *Am J Health Promot*. 2018;32(4):865–879. [doi:10.1177/0890117116675785](https://doi.org/10.1177/0890117116675785)
- Love, R., Adams, J., & van Sluijs, E. M. F. (2019). Are school-based physical activity interventions effective and equitable? A meta-analysis of cluster randomized controlled trials with accelerometer-assessed activity. *Obes Rev*, 20(6), 859-870. [doi:10.1111/obr.12823](https://doi.org/10.1111/obr.12823)

- Lubans, D., & Morgan, P. (2008). Evaluation of an extra-curricular school sport programme promoting lifestyle and lifetime activity for adolescents. *Journal of Sports Science*, 26(5), 519-529. doi:10.1080/02640410701624549
- Macdonald-Wallis, K., Jago R., & Sterne, J.A. (2012). Social network analysis of childhood and youth physical activity: A systematic review. *American Journal of Preventive Medicine*, 43:636–42. 10.1016/j.amepre.2012.08.021
- Markland, D., & Tobin, V. (2004). A modification of the Behavioral Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*, 26(2), 191-196. doi:10.1123/jsept.26.2.191
- Martin Ginis, K.A., Nigg, C.R., & Smith, A.L. (2013). Peer-delivered physical activity interventions: An overlooked opportunity for physical activity promotion. *Translational Behavior Medicine*, 3, 434–43. 10.1007/s13142-013-0215-2
- McMurray, R. G., Harrell, J. S., Deng, S., Bradley, C. B., Cox, L. M., & Bangdiwala, S. I. (2000). The influence of physical activity, socioeconomic status, and ethnicity on the weight status of adolescents. *Obesity research*, 8(2), 130–139. <https://doi-org.proxy1.cl.msu.edu/10.1038/oby.2000.14>
- Minjin, R., Jang, Y., & Peng, W. (2020). *Games for Health Journal*, 85-94.<http://doi.org/10.1089/g4h.2018.0134>
- Mouratidis, A. & A. Michou (2011). Perfectionism, self-determined motivation, and coping among adolescent athletes. *Psychology of Sport & Exercise*, 12(4), 355-367.
- National Physical Activity Plan Alliance. The 2018 United States Report Card on Physical Activity for Children and Youth. Washington, DC: National Physical Activity Plan Alliance, 2018.
- Ntoumanis, N., Ng, J., Prestwich, A., Quested, E., Hancox, J., Thøgersen-Ntoumani, C., Deci, E., Ryan, R., Lonsdale, C., & Williams, G., 2020. A meta-analysis of self-determination theory-informed intervention studies in the health domain: Effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review*. Feb 3:1-31. doi: 10.1080/17437199.2020.1718529.
- Oluwasanu, M. & Oladepo, O. (2017). Effects of a multi-level intervention on the pattern of physical activity among in-school adolescents in Oyo state Nigeria: A cluster randomised trial. *BMC Public Health* 17: 1-11.
- Owen, K., Smith, J., Lubans, D., Ng, J., & Lonsdale, C. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive Medicine*, 67, 270-279. doi:10.1016/j.ypmed.2014.07.033

- Palmer, K., Robbins, L.B., Ling, J., Kao, T., Voskuil, V.R., & Smith, A.L, (2020). Adolescent autonomous motivation for physical activity: A concept analysis, *Journal of Pediatric Nursing*, ISSN 0882-5963, doi.org/10.1016/j.pedn.2020.04.020.
- Pate, R. R., Ward, D. S., Saunders, R. P., Felton, G., Dishman, R. K., & Dowda, M. (2005). Promotion of physical activity among high-school girls: a randomized controlled trial. *American journal of public health*, 95(9), 1582–1587. <https://doi.org/10.2105/AJPH.2004.045807>
- Pietiläinen, K. H., Kaprio, J., Borg, P., Plasqui, G., Yki-Järvinen, H., Kujala, U. M., Rose, R. J., Westerterp, K. R., & Rissanen, A. (2008). Physical inactivity and obesity: a vicious circle. *Obesity (Silver Spring, Md.)*, 16(2), 409–414. <https://doi.org/10.1038/oby.2007.72>
- President’s Council on Fitness, Sports and Nutrition. Facts and Statistics (n.d.). (2017) Retrieved from: <https://www.hhs.gov/fitness/resource-center/facts-and-statistics/index.html>
- Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Connor Gorber, S., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *The international journal of behavioral nutrition and physical activity*, 5, 56. <https://doi.org/10.1186/1479-5868-5-56>
- Ratey, J. J., & Hagerman, E. (Collaborator). (2008). Spark: The revolutionary new science of exercise and the brain. Little, Brown and Co.
- Reinehr, T. (2018). Long term effect of obesity: Time to act. *Nature Reviews Endocrinology*, 14. doi: 10.1038/nrendo.2017.147
- Rideout, V., and Robb, M. B. (2019). The Common Sense census: Media use by tweens and teens, 2019. San Francisco, CA: Common Sense Media.
- Robert Wood Johnson Foundation, (2019). State of Childhood Obesity, helping all children grow up health. Retrieved from: <https://media.stateofobesity.org/wp-content/uploads/2019/11/18171114/SoCo-Report-WEB-111819.pdf> March 23, 2020.
- Rodgers B. (2000). Concept analysis: An evolutionary view. *Concept Development in Nursing: Foundations, Techniques and Applications*, 2nd edn (Rodgers, B.I. & Knafl K.A., eds), iSaunders, Philadelphia, PA, pp. 77-102.
- Ryan, R., & Deci, E. (2017). Self-Determination theory. Basic psychological needs in motivation, development and wellness. Guilford Press, New York, London.
- Schneider, M. & Kwan, B. (2013). Psychological need satisfaction, intrinsic motivation and affective response to exercise in adolescents. *Psychology of Sport Exercise*, 14(5), 776-785.

- Shen, B. (2014). Outside-school physical activity participation and motivation in physical education. *British Journal of Education Psychology*, 84(Pt 1), 40-57. doi:10.1111/bjep.12004
- Standage, M., Duda, J.L., & Ntoumanis, N.(2005). A test of self-determination theory in school physical education. *British Journal of Education Psychology*, 75:411–33. 10.1348/000709904X22359
- Stalsberg, R., & Pedersen, A. V. (2010). Effects of socioeconomic status on the physical activity in adolescents: a systematic review of the evidence. *Scandinavian journal of medicine & science in sports*, 20(3), 368–383. <https://doi-org.proxy1.cl.msu.edu/10.1111/j.1600-0838.2009.01047.x>
- Starks, H., & Brown Trinidad, S. (2007). Choose Your Method: A Comparison of Phenomenology, Discourse Analysis, and Grounded Theory. *Qualitative Health Research*, 17(10), 1372–1380. <https://doi.org/10.1177/1049732307307031>
- Stults-Kolehmainen, M. A., & Sinha, R. (2014). The effects of stress on physical activity and exercise. *Sports Med*, 44(1), 81-121. doi:10.1007/s40279-013-0090-5
- Sylvia, L. G., Bernstein, E. E., Hubbard, J. L., Keating, L., & Anderson, E. J. (2014). Practical guide to measuring physical activity. *Journal of the Academy of Nutrition and Dietetics*, 114(2), 199–208. <https://doi.org/10.1016/j.jand.2013.09.018>
- Teixeira, P.J., Carraça, E.V., Markland, D., Silva, M.N., & Ryan, R.M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavior Nutrition Physical Activity*, 9:78. 10.1186/1479-5868-9-78
- Thivel, D., Tremblay, A., Genin, P. M., Panahi, S., Rivière, D., & Duclos, M. (2018). Physical activity, inactivity, and sedentary behaviors: Definitions and implications in occupational health. *Frontiers in Public Health*, 6, 288. <https://doi.org/10.3389/fpubh.2018.00288>
- Thompson, D., Cantu, D., Ramirez, B., Cullen, K. W., Baranowski, T., Mendoza, J., . . . Yan, L. (2016). Texting to increase adolescent physical activity: Feasibility assessment. *American Journal of Health Behavior*, 40(4), 472-483. doi:10.5993/AJHB.40.4.9
- Thompson, D., Deatrick, J. A., Knafl, K. A., Swallow, V. M., & Wu, Y. P. (2022). A Pragmatic Guide to Qualitative Analysis for Pediatric Researchers. *Journal of pediatric psychology*, jsac040. Advance online publication. <https://doi.org/10.1093/jpepsy/jsac040>
- Trost, S.G., (2007). State of the art reviews: Measurement of physical activity in children and adolescents. *American Journal of Lifestyle Medicine*, 1(4), 299-314. Doi: 10.1177/155987607301686
- Van de Kop, J.H., Van Kernebeek, W.G., Otten, R., Toussaint, H., Verhoeff, A. (2019).

- School-based physical activity interventions in prevocational adolescents: A systematic review and meta-analyses. *Journal of Adolescent Health*, 65(2), 185-194. doi.org/10.1016/j.jadohealth.2019.02.022.
- Vlachopoulos, S. P., Ntoumanis, N., & Smith, A. L. (2010). The basic psychological needs in exercise scale: Translation and evidence for cross-cultural validity. *International Journal of Sport and Exercise Psychology*, 8(4), 394-412. doi:10.1080/1612197X.2010.9671960
- Wang, L. (2017). Using the self-determination theory to understand Chinese adolescent leisure-time physical activity. *European Journal of Sport Science*, 17(4), 453-461. doi.org/10.1080/17461391.2016.1276968
- Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the internet to promote health behavior change: A systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of medical Internet research*, 12(1), e4. https://doi.org/10.2196/jmir.1376
- Wilson, P.M., Rodgers, W.M., Loitz, C.C., & Scime, G. (2006). "It's who I am...really!" The importance of integrated regulation in exercise contexts. *Journal of Biobehavioral Research*, 11, 79-104.
- World Health Organization (2018). Global strategy on diet, physical activity and health. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_young_people/en/ on 29 August 2018.
- Yew Meng, H., Whipp, P., Dimmock, J., & Jackson, B. (2013). The Effects of Choice on Autonomous Motivation, Perceived Autonomy Support, and Physical Activity Levels in High School Physical Education. *Journal of Teaching in Physical Education*, 32(2), 131-148.

CHAPTER TWO: ADOLESCENT AUTONOMOUS MOTIVATION FOR PHYSICAL ACTIVITY: A CONCEPT ANALYSIS

Abstract

Purpose. The purpose of this concept analysis is to develop a clear definition of adolescent autonomous motivation for physical activity (PA) based on all existing theoretical and operational definitions of autonomous motivation noted in the literature. For providers, understanding this is essential to elucidate why some adolescents choose to participate in a health-promoting behavior like PA. Researchers need to identify if they are evaluating autonomous motivation or a different type.

Methods. Rodger's Evolutionary Method of concept analysis was used. PubMed, CINAHL, ERIC, PsychInfo, and Sport Discus were searched.

Results. No concept analysis of adolescent autonomous motivation for PA was found. Autonomous motivation may include intrinsic motivation and two forms of extrinsic motivation, integrated and identified behavioral regulations. Defining attributes include being: 1) dynamic and 2) on a continuum. Adolescent autonomous motivation for PA is the self-desire to be active because PA is fun and enjoyable, or PA is part of how the adolescent maintains a healthy lifestyle and part of who the adolescent identifies as being (as being an athlete or healthy).

Conclusion. Findings are that an autonomy-supportive environment and positive perceptions of PA are needed in order to have the outcome of increased PA. The information may be helpful for promoting consistency of measurement across disciplines. Future research with adolescents is warranted to examine underlying differences between males and females, by age, weight status, and developmental stage.

Practice Implications. An in-depth understanding is needed for providers who are interested in developing interventions to assist adolescents in regularly attaining adequate PA.

Introduction

Recent estimates from the President's Council on Fitness, Sports, and Nutrition (2017) indicate that 80% of adolescents do not meet current physical activity (PA) guidelines calling for at least 60 minutes daily of mostly moderate to vigorous PA (MVPA) (Piercy et al. 2018; World Health Organization, 2018). The Centers for Disease Control and Prevention (CDC, 2017) emphasize that inadequate PA contributes to excessive weight gain at a young age, indicating an urgent need for intervention. In the United States (U.S.), the most recent projections report that by 2030 more than 85% of adults will be overweight or obese (Hruby & Hu, 2015), indicting an urgent need for intervention before adulthood is reached. Obesity greatly increases the risk of chronic disease morbidity, including-disability, depression, Type 2 diabetes, cardiovascular disease and certain cancers, in both children and adults (Hruby & Hu, 2015). Targeting various psychosocial factors related to the behavior, such as adolescents' autonomous motivation for PA, may be a necessary step toward increasing their PA (Vierling et al., 2007; Wang, 2017).

Although regular PA is essential for improving the health, energy, and productivity of adolescents (Murdaugh et al., 2019), increased use of technology in this young population has contributed to adolescent's inability to meet the recommended guidelines for PA (Piercy et al., 2018). Accumulating evidence indicates that it is more beneficial to assist adolescents in developing behaviors like PA at this young age, rather than trying to change already established unhealthy habits later in life (Murdaugh et al., 2019; Richards, 2015). Because adolescents spend most of their time in school, school is an essential venue for providing adolescents with the opportunity to engage in PA (Dobbins et al., 2013). School nurses, as the healthcare providers

onsite, have a crucial role in assisting adolescents to achieve the PA goal at school (Cowell, 2014). Additionally, nurses in primary care settings, because of their frequent contact and ability to develop trusting relationships with adolescents, are also well positioned to help motivate adolescents to engage in PA (Murdaugh et al., 2019; Richards, 2015).

Adolescence is an important time of growth and development during which adolescents crave peer acceptance and seek opportunities to develop autonomy and independence from parents/guardians (Healthy People, 2020; Jarvis, 2019). Autonomy among adolescents is identified as their basic need to experience behavior as volitional (Fullmer et al., 2018). In addition, feeling competent with their skills related to PA is important during this developmental period (Jarvis, 2019; Sterdt et al., 2014). Rapid physical changes occurring during this time may increase body image concerns and unhealthy weight control practices, and either increase or decrease adolescents' willingness to participate in PA. These body image concerns may lead to anorexia, bulimia, or fad dieting, all of which could negatively impact energy level and affinity for PA. In light of these changes, adolescents may feel challenged in a PA setting, and their autonomous motivation for PA can suffer. Therefore, it is important to understand and address adolescent autonomous motivation for PA.

Educators, as well as psychologists and other health professionals, use autonomous motivation with limited conceptual clarity (Singh, 2016). Occupational health providers seek for employees to be autonomously motivated and use various techniques to accomplish this such as a focus on enjoyment of their work (Singh, 2016). When educators focus on autonomous motivation, they refer to behavior which is goal-directed towards self-learning (Niemic & Ryan, 2009). For nurses and other health professionals caring for adolescents, understanding autonomous motivation is essential to elucidate why some adolescents choose to participate in a

health-promoting behavior and others do not. Concerns about adolescents' inadequate PA have resulted in an increased interest in examining adolescent autonomous motivation for PA (DeMeester et al., 2017; Dishman et al., 2018). Unfortunately, researchers have employed various conceptual definitions and measures of adolescent autonomous motivation for PA, and findings regarding how adolescent autonomous motivation for PA impacts an adolescents' PA have been inconsistent (Owen et al., 2014; Owen et al., 2017). Despite the importance of clarifying adolescent autonomous motivation for PA, no analysis of the concept was found that achieved this objective. Therefore, the purpose of this paper is to present an analysis of the concept of autonomous motivation for PA by identifying its defining attributes, related concepts/surrogate terms, antecedents, and consequences. To build on the current, but limited, understanding of adolescent autonomous motivation for PA, this paper will propose a conceptual definition formulated from a comprehensive review and integration of the theoretical and empirical literature.

Theory and Background

Self Determination Theory (SDT) provided a framework for the process and helped to guide the analysis to yield a definition of the concept. SDT originated in the 1970s and developed further in the mid-1980s (Deci & Ryan, 1985, 2008). Self Determination Theory did not identify motivation as being a singular concept, similar to other motivation theories; instead, the theory developed and differentiated among various types of motivation. For example, SDT (Deci & Ryan, 1985) originally proposed the construct of autonomous motivation. Deci and Ryan (1985) distinguished between autonomous motivation versus controlled motivation. They defined autonomous motivation as comprising both intrinsic motivation and the types of extrinsic motivation in which people have identified the value of the activity and integrated it into their

sense of self. This autonomous motivation leads to an experience that can be self-endorsing (Deci & Ryan, 2008). However, the definition of autonomous motivation in the theory is not behavior specific. Given that individuals' motivation may vary based on a specific behavior like PA, a clear definition of adolescent autonomous motivation for PA is needed in order to ensure accurate measurement of the concept in PA research.

Although some success has been achieved from interventions aimed at increasing adolescent PA (Owen et al., 2013; Wilson et al., 2005), overall effects have been minimal with limited maintenance of the behavior over time (Owen et al., 2017). Although important, understanding adolescent autonomous motivation for PA is a complex process, particularly because different types of motivation exist. Therefore, a comprehensive analysis of the concept is important. SDT is useful because it offers information about antecedents of autonomous motivation which include autonomy, competence, and relatedness (Aelterman et al., 2016; Gunnell et al., 2016; McDavid et al., 2014; Wang, 2017). Although some interventions fostering these three antecedents have ultimately resulted in the attainment and sustainment of an adequate level of PA (Minatto et al., 2016; Owen et al., 2014), others have not been successful (Owen et al., 2017). Regardless, based on longitudinal work involving objective assessment of PA, Dishman and colleagues (2018) assert that future research should emphasize building autonomous motivation for PA in interventions.

In a systematic review and meta-analysis of children and adolescents (ages 5-18 years), researchers found autonomous motivation had a positive association with PA (Owen et al., 2014). Autonomous motivation was defined as including intrinsic (e.g., I participate because it is interesting and enjoyable) plus integrated (e.g., I participate because this aligns with my sense of self) and identified (e.g. I participate because this behavior is beneficial and important) forms of

motivation (Owen et al., 2014). In addition, Li and colleagues (2014) found that adolescents with higher autonomous motivation and more active friends were more likely to participate in MVPA. This finding suggests that social support from friends or being connected to active friends may be important for building autonomous motivation for PA. In a student-centered intervention based on the SDT and Social Cognitive Theory, Wilson et al., (2005) demonstrated that psychosocial factors of autonomous motivation, self-efficacy, and self-concept predicted PA (Wilson et al., 2005). In contrast, however, Timo et al. (2016) found that autonomous motivation and enjoyment in physical education in grade seven did not predict future PA.

The sharp decline in PA during adolescence has generated increased research directed towards enhancing adolescent autonomous motivation for PA with inconsistent effect on improving PA. Consistency in defining and measuring a specified concept is essential to advancing theory and effectively using it to design interventions that increase adolescents' autonomous motivation for PA. While theory-based interventions aimed at increasing adolescent autonomous motivation for PA may potentially increase PA, concepts in these theories need to be consistently defined and measured to determine their full explanatory power. Developing a concept analysis is the first step in defining adolescent autonomous motivation for PA. This step is important to ensure the definition aligns with the operational measure.

Methods

Data Sources

The authors completed a literature review related to adolescent autonomous motivation for PA utilizing the following databases: Cumulative Index of Nursing and Allied Health Literature (CINAHL), Education Resources Information Center (ERIC), PsychINFO, PubMed and SPORT Discus. Prior to the search being conducted by the first author, a health sciences

librarian assisted with devising the literature search terms and reviewed the search process with the first author. Key words used for the review were motivation, autonomous motivation, adolescents or teenagers or young adults and physical activity or exercise or fitness or physical exercise. Inclusion criteria were: original studies, written in English, time frame up to November 2019, addressed autonomous motivation or motivation and PA as concepts, and involvement of adolescents from ages 12 through 18 years. Abstracts were excluded if they were: conferences, dissertations, editorials, systematic reviews, articles on adults, and motivation related to behaviors other than PA. After removing 446 duplicates, a total of 1525 abstracts were screened and 96 were retained. After reviewing the 96 full-text articles, an additional 28 articles were excluded because they did not meet the above inclusion criteria. As a result, 68 articles remained for final inclusion in the analysis. Figure 2.1 provides a summary of the literature search results.

The 68 full-text articles that remained were from the following databases: SportDiscus ($n=19$), PubMed ($n=18$), CINAHL ($n=6$), ERIC ($n=5$), and PsychInfo ($n=20$). The articles represented a variety of disciplines which were determined based on the background or college affiliation of each first author, as reported in the publication and/or matched with the article content. Disciplines included: Sport Science ($n=19$), Health ($n=18$), Education ($n=10$), and Psychology ($n=9$). Tofthagen and Fagerstrom (2010) reported that databases can overlap, and disciplines may need to be identified based on the article content. For 12 articles, information on the first author's discipline or college affiliation was not provided. After carefully reviewing the articles, the following classifications were assigned: Education ($n=8$), Psychology ($n=2$), and Health ($n=2$). Of the 68 selected articles, 42 (61%) had an international focus. The studies were also strongly focused on quantitative statistics with 59 (87%) of the articles being quantitative, seven being qualitative and two utilizing a mixed-methods approach. Although, 68 articles were

reviewed, only 20 (29%) provided a conceptual definition of autonomous motivation. The remaining articles only mentioned autonomous motivation with no initial clear definition.

Using the preestablished inclusion and exclusion criteria, the first and second author carefully and independently examined each selected article for critical attributes related to adolescent autonomous motivation for PA and then for antecedents and consequences associated with the concept. Lastly, the authors formulated a conceptual and operational definition. The first and second authors entered all relevant information related to each area into an Excel 2016 (Version 1811) database and discussed the findings with each other. The first and second authors discussed all discrepancies until agreement was reached. If consensus could not be achieved, they consulted a third author (Charrios, 2015).

Procedure

The authors used Rodger's Evolutionary Model (2000) to conduct this concept analysis. Rodgers (2000) recommends using this model for concepts that change over time as more research is generated, similar to adolescent autonomous motivation for PA. Rodger's (2000) model is also used to analyze concepts that vary across contextual circumstances, such as those related to PA (Tofthagen & Fagerström, 2010). The author's identified the concept of adolescent autonomous motivation for PA for the analysis and identified surrogate terms. The first author searched five different databases with the key terms and no time constraints on the search. The first and second authors reviewed the literature and completed an analysis of the antecedents, attributes, consequences, and conceptual definitions from the selected literature. The first author created an exemplar from the findings and generated future implications regarding adolescent autonomous motivation for PA. Table 2.1 provides additional information on this process.

Table 2.1: Rodger's Evolutionary Model of Concept Analysis: Autonomous Motivation for PA in Adolescents

Steps of Model	Autonomous Motivation Results
1. Identify and name the concept of interest	1. Concept: adolescent autonomous motivation for PA
2. Identify and select the setting for data collection	2. Disciplines: education, psychology, medicine, nursing, sports Databases: CINAHL, PsychINFO, ERIC, PubMed, SPORTDiscus Abstract time period: all dates- November 2019
3. Identify and select appropriate sample for data collection	3. Review of the literature and data coding process: 68 relevant articles were identified; articles were reviewed for attributes, antecedents, consequences, and definitions.
4. Identify attributes of the concept	4. Defining attributes: autonomous motivation is on a continuum and is dynamic.
5. Identify the antecedents and consequences of the concept	5. Antecedents: autonomy-supportive environment & positive perceptions of PA. Consequences: Increased PA
6. Identify related concepts	6. Concepts related to autonomous motivation: commitment, intention, drive
7. Identify the model case of the concept	7. An exemplar was created to highlight the identified characteristics of autonomous motivation

Results

Rodgers (2000) specified conceptual definitions as the meaning and use of the concept. The authors analyzed conceptual definitions of adolescent autonomous motivation for PA from the literature for similarities, differences, and key words/phrases. The most notable findings were: (1) the literature mentioned autonomous motivation, but a clear conceptual definition was not always provided, and (2) a variety of empirical measures were used in different research studies. Table 2.2 lists the conceptual definitions that were identified in the literature.

Table 2.2: Conceptual definitions for autonomous motivation related to physical activity in adolescents

Source (Year)	Conceptual Definitions
Boiche & Sarrazin, (2007)	They are more or less personally assumed and fully integrated in the individual's self
Markland & Ingledew, (2007)	Reflecting the extent to which the regulation of a behavior has become internalized and integrated into the person's sense of self so that they feel that they are engaging in the behavior freely, with no sense of compulsion and in accordance with their personal values
Vansteenkiste, Matos & Soenens, (2007)	Individuals perform the exercise activity because they want to (i.e., out of choice)
Vierling et al. (2007)	Participating in activities that an individual freely chooses to engage in (i.e., intrinsic motivation and identified regulation)
Cox, & Ullrich-French (2010)	Motivation that is self-determined emanates from sources within the self (e.g., experiencing enjoyment and satisfaction from the activity) rather than sources outside of the self (e.g., pressure from others, avoiding punishment) and is purported to lead to more positive cognitive, affective and behavioral consequences.
Mouratidis et al. (2011)	Refers to activities that athletes volitionally undertake because they either find them interesting and enjoyable (intrinsic motivation), or fully internalize them in their own self (integrated regulation), or internalize them to some considerable degree because they consider them personally important (identified regulation).
Gillison et al. (2011)	For pleasure, or the value of an activity
Owen et al. (2013)	Regulated by enjoyment or personal values
Fenton et al. (2014)	As the source of behavior regulation emanates from the self
Dishman et al. (2015)	Includes intrinsic motivation, integrated and identified regulation
Karagiannidis et al. (2015)	Intrinsic motivation and identified regulation
Aelterman et al. (2016)	Refers to the enactment of an activity for the excitement, enjoyment, and interest inherent to the activity itself (i.e., intrinsic motivation),
Gaudreau et al. (2016)	Self-determined motivation is characterized by the pursuit of an activity perceived to be important for the person and/or pursued because of the mere interest for the activity.
Ferriz et al. (2016)	Reflects reasons for engaging in behaviors out of a sense of choice, volition, and sense of ownership of the action
Timo et al. (2016)	Includes intrinsic motivation, integrated and identified regulation
Sicilia et al. (2016)	The person engages in exercise by choice.
Lubans et al. (2016)	Includes intrinsic and identified

Table 2.2 (cont'd)

Source (Year)	Conceptual Definitions
DeMeester et al. (2017)	Is the most optimal form of motivation and relates to the engagement in an activity for its own sake, out of interest or enjoyment or because the behavior has been brought into alignment with the individual's other values and ideals
Kerner et al. (2017)	Is the most self-determined and is a combination of intrinsic motivation (undertaking an activity for the inherent pleasure), integrated regulation (undertaking an activity through choice to obtain a personal goal), and identified regulation (when the outcome of the behavior is valued such as the health benefits of physical activity).
Dishman et al. (2018)	Includes intrinsic motivation and several forms of extrinsic motivation that vary according to whether they are internalized or externally controlled: integrated regulation (the act of physical activity is fully part of self-identity or core personal values) and identified regulation (partial internalization of physical activity outcomes as personal values and self-identity)

Self Determination Theory (Ryan & Deci, 2017) described autonomous motivation as including intrinsic motivation and two forms of extrinsic motivation, which are referred to as integrated and identified behavioral regulations. Integrated regulation is the most autonomous type of extrinsic motivation and occurs when the adolescent fully assimilates PA with the self (Ryan & Deci, 2017). Identified regulation, with regard to PA, occurs because the adolescent recognizes the value, purpose, and benefit of the behavior, such as being beneficial for health (Kerner et al., 2017). Intrinsic motivation is noted when PA is done for enjoyment, fun, interest, or satisfaction (Ryan & Deci, 2017). In other words, the individual is moved to do something. Extrinsic motivation is a behavior that is done to avoid punishment, gain an external reward or for social approval (Ryan & Deci, 2017).

Defining Attributes

Rodgers (2000) described defining attributes as the concept's characteristics. Based on the information included in the reviewed articles, the defining attributes of autonomous

motivation for PA are being: 1) dynamic; and 2) on a continuum from integrated or identified extrinsic motivation to intrinsic motivation (Dishman et al., 2018; Jõesaar et al., 2012; O'Loughlin et al., 2015).

Dynamic. Adolescent autonomous motivation for PA is dynamic (DeMeester et al., 2017; Dishman et al., 2018; Kerner & Goodyear, 2017; Timo et al., 2016). It can be elicited and sustained by some conditions and subdued and diminished by others (Ryan & Deci, 2017). Adolescent autonomous motivation for PA can be reflective or automatic. Reflective motivation, which is a process involving plans and evaluation, may be aligned with sustained autonomous motivation (Kwan et al., 2017). Automatic motivation is a process involving emotions and impulses that arise from associative learning and/or innate dispositions (e.g. habits and routines) and may be important for initiating behavior (Kwan et al., 2017). For some adolescents, autonomous motivation may only consist of intrinsic motivation, while for others, autonomous motivation may be a combination of intrinsic, integrated and/or identified motivation. See Table 2.3 for examples from the literature.

Table 2.3: Defining attributes of adolescent autonomous motivation for physical activity

Defining Attribute	Characteristics (sources)
Continuum	
	Motivation that is self-determined emanates from sources within the self (e.g., experiencing enjoyment and satisfaction from the activity) rather than sources outside of the self (e.g., pressure from others, avoiding punishment) and is purported to lead to more positive cognitive, affective and behavioral consequences (Cox et al. 2010)

Table 2.3 (cont'd)

Defining Attribute	Characteristics (sources)
	Autonomous motivation refers to activities that athletes volitionally undertake because they either find them interesting and enjoyable (intrinsic motivation), or fully internalize them in their own self (integrated regulation) or internalize them to some considerable degree because they consider them personally important (identified regulation). (Mouratidis et al. 2011)
	Motivation is multidimensional and resides along a continuum of self-determination ranging from more controlled types of motivation (e.g., acting in response to external pressures such as reward or punishment, or internal cues such as guilt) to more autonomous forms of motivation (e.g., for pleasure, or the value of an activity). (Gillison et al. 2011)
	Behavioral engagement is motivated according to one's position along a graded continuum of regulations ranging from amotivation to external motivation and to internal motivation (Hwang et al. 2013)
	Intrinsic motivation; <i>motivation continuum</i> (Li et al. 2014)
	Students with higher levels of autonomy, relatedness, intrinsic motivation, and identified regulation had higher levels of physical activity at baseline and throughout the study (McDavid et al. 2014)
	Motivation exists on a continuum ranging from amotivation through four types of extrinsic motivation (external regulation, introjected regulation, identified regulation and integrated regulation) to intrinsic motivation (Timo et al. 2016)
	Motivation is a multidimensional construct that can be placed on a continuum ranging from completely autonomous or self-determined (i.e., the person engages in exercise by choice) to completely controlling or non-self-determined (i.e., the person feels forced or pressured into exercising, either by others or by himself or herself). (Sicilia et al. 2016)
	Changes in basic psychological needs and the two types of autonomous motivational regulations (intrinsic and identified) as well as introjected regulation were positively associated with changes in well-being over the 8-month study period. (Lubans et al. 2016)
	Autonomous motivation is the most self-determined and is a combination of intrinsic motivation (undertaking an activity for the inherent pleasure), integrated regulation (undertaking an activity through choice to obtain a personal goal), and identified regulation (when the outcome of the behavior is valued such as the health benefits of physical activity). (Kerner et al. 2017)

Table 2.3 (cont'd)

Defining Attribute	Characteristics (sources)
	Autonomous motivation includes intrinsic motivation and several forms of extrinsic motivation that vary according to whether they are internalized or externally controlled: integrated regulation (the act of physical activity is fully part of self-identity or core personal values) and identified regulation (partial internalization of physical activity outcomes as personal values and self-identity) (Dishman et al. 2018)
Dynamic	
	Introjected regulation was found to be associated with highly adaptive levels of physical activity, and to coexist with more self-determined (identified and intrinsic) motivation for sport and exercise without apparent negative effects. This finding is consistent with research that suggests that introjected regulation can be an adaptive form of motivation in the short term (although not in the long term; Pelletier et al., 2001), and a necessary stage of the process of the internalization of behavioral motivation (Deci et al., 1994) (Gillison et al. 2009)
	Perceived autonomy support from the coach and task involving peer climate had significant positive effect on athlete's intrinsic motivation (Jõesaar et al. 2012)
	Introjected regulation is a <i>'gateway' to internalization</i> and self-determination and therefore may play a role in how adolescent girls adopt and sustain activities such as exergaming (O'Loughlin et al. 2015)
	Measures of autonomous motivation (identified, integrated, and intrinsic) were more strongly related to physical activity in the seventh grade than measures of controlled motivation (external and introjected), implying that physical activity became more intrinsically motivating for some girls and boys as they moved through middle school (Dishman et al. 2015)
	Children can have varying degrees of multiple motives and goals acting concurrently and that intrinsic motivation and instrumental motives and goals can have additive influences on behavior (Dishman et al. 2018)

Continuum. Adolescent autonomous motivation for PA is on a continuum – ranging from two forms of extrinsic to the highest form of motivation, which is intrinsic (Ryan & Deci, 2000). Intrinsic motivation is internally driven and self-determined to produce long-term behavioral change (Aelterman et al., 2016; Craike et al., 2014; De Meester et al., 2017; Wang, 2017). Intrinsic motivation occurs because of inherent interest and enjoyment in and a

satisfaction with an activity (Aelterman et al., 2016; Craike et al., 2014; De Meester et al., 2017; Wang, 2017), with no outside sources or pressures influencing the decision to participate in the activity (Aelterman et al., 2016; Dishman et al., 2018; Fullmer et al., 2018; Wang, 2017).

Extrinsic motivation includes two different behavioral regulations that may be part of autonomous motivation, referred to as integrated and identified (Ryan & Deci, 2017). Integrated regulation is evident when PA is enacted because the adolescent perceives that PA is part of who they are (Dishman et al., 2018). Identified regulation refers to behavior for PA that occurs because the adolescent recognizes the value, purpose, and benefit of the behavior, such as being beneficial for health (Kerner et al., 2017). Adolescents can move within the continuum depending on the degree that the environment is perceived as being autonomy supportive and whether or not perceptions of PA are positive.

Related Concepts/Surrogate Terms

Surrogate terms or related concepts are terms that may have something in common with the concept or are used similarly (Rodgers, 2000).

Intention. Intention and intentionality are used as surrogate terms for adolescent autonomous motivation for PA (De Meester et al., 2017; Gaudreau et al., 2016; McDavid et al., 2014; Sicilia et al., 2016). Often in behavioral change theories, the terms are used interchangeably, but intention is an individual's stated orientation towards a behavior and the course of action the individual plans to follow (Ajzen, 2011). However, autonomous motivation is not synonymous with an intention to carry out a behavior. Autonomous motivation is dynamic and is on a continuum; adolescent autonomous motivation for PA involves personal needs and forces that together provide energy for individuals to act on the environment and engage in PA (Deci & Ryan, 1985). Although intention may also be dynamic, intention is not on a continuum.

For example, an adolescent will either intend to participate in PA or not intend to participate in the behavior (Gillison et al., 2014; Karagiannidis et al., 2015; McDavid et al., 2014; Sicilia et al., 2016). This information suggests that an adolescent's autonomous motivation for PA may predict future intention to be physically active or may be needed to carry out an intended behavior (Sicilia et al., 2016).

Drive. The term drive has been used interchangeably with the term autonomous motivation. The Drive Theory of Motivation (Ryan & Deci, 2017) indicates that people are driven to behave in order to reduce the internal tension caused by unmet needs. Drive or impulses account for tendencies to act, but they do not provide an adequate theory of action needed for motivation (Deci & Ryan, 1985). Drive theories cannot deal with the complexities of human behavior, whereas motivation theories are built on a set of assumptions about the nature of people and the factors that give energy action (Deci & Ryan, 1985). Motivation is described in conceptual definitions as the drive to act or as being driven to act (Gillison et al., 2013; Li et al., 2014; Sebire et al., 2013). Gillison et al., (2013) described motivation as being driven by inherent qualities such as interest and enjoyment. Autonomous motivation involves the internal process of needs, emotions, and cognitions that provide the energy and drive for behavior (Bengoechea & Streat, 2007). Although drive may be dynamic based on whether the PA needs of the adolescent are met, drive is either present or not present (Gillison et al., 2013; Li et al., 2014; Sebire et al., 2013).

Commitment. Commitment was another term used interchangeably with autonomous motivation in the literature. According to Robbins et al., (2017), commitment is a desire and resolve to continue to participate in PA through self-directed goal setting. Commitment reflects a cognitive decision to act on what motivates an individual (Silva et al., 2010); therefore, it

happens when autonomous motivation is in place (Silva et al., 2010). When individuals have autonomous motivation, they engage in the PA, develop commitment, and then have great well-being to carry out PA (Silva et al., 2010). Taking a different perspective, Debate et al., (2009) proposed that motivation was a component of commitment; however, Williams (2013) asserted that commitment impacted one's motivation for involvement. Commitment is also not on a continuum. An adolescent is either committed to PA or not committed to PA; the commitment may be dynamic based on their positive perceptions of PA and the autonomy-supportive environments for PA that they participate in (Debate et al., 2009; Silva et al, 2010; Williams, 2013).

Antecedents

Antecedents are the events that have occurred prior to or have been previously associated with the concept (Rodgers, 2000). Based on the literature, the identified antecedents for the concept of adolescent autonomous motivation for PA include an autonomy-supportive environment (Gillison et al., 2014; Shen, 2014) and positive perceptions of PA (Hassandra et al., 2003; See Table 2.4 for examples from the literature).

Table 2.4: Antecedents of adolescent autonomous motivation for physical activity

Antecedent	Examples
Autonomy Supportive Environment	Social relationships above and beyond the current physical education literature has supported the individual role that positive relationships with teachers and peers play in explaining adaptive motivational experiences in physical education (Cox et al. 2010).
	Task involving motivational climate positively influences the three basic needs of autonomy, relatedness and competence (Jõesaar et al. 2011).
	Significant others such as teachers and parents can influence self-determined motivation through different forms of social support (McDavid et al. 2012)

Table 2.4: (cont'd)

Antecedent	Examples
	Internal motivation to exercise might be cultivated by repeated exposure to exercise experiences that generate acute positive effects and by a needs supportive social context (Schneider et al. 2013)
	People of authority can have an impact on student's motivation (Owen et al. 2013)
	Social context and social support ; action planning may serve as a necessary bridge between motivation and behavior (Li et al. 2014)
	Supportive environments that support autonomy, build relationships and develop knowledge (Shen et al. 2014).
	The social environment created in the youth sport setting is linked to daily levels of moderate to vigorous physical activity (Fenton et al. 2014)
	Social contexts that are supportive of autonomy, competence and relatedness fosters a person's health and wellbeing (Gillison et al. 2014)
	Social affiliation impacts students' sustained participation more. When students felt connected to their leader and peers, the groups fostered a sense of accountability that positively impacted attendance and participation (Whalen et al. 2016).
	Social environments can hinder or satisfy the needs (Wang et al. 2017)
Positive Perceptions of PA	Individual differences in perceived competence, perceived autonomy , goal orientation, perceived usefulness of the lesson, and physical appearance, are associated with students' intrinsic motivation (Hassandra et al. 2003).
	Perceptions of autonomy, competence, and relatedness in physical education are positive predictors of effort and enjoyment in class, autonomous motivation for class participation, intentions for leisure-time physical activity, and self-reported physical activity behavior, and perceptions of relatedness are a negative predictor of worry in class (McDavid et al. 2014)

Autonomy-Supportive Environment. The social environment can be supportive or hinder motivation for PA among adolescents. A term used in the literature to describe a supportive environment is “autonomy-supportive” (Aelterman et al., 2016; DeMeester et al., 2017). In an autonomy-supportive environment, individuals feel they are in control of their lives and can make choices surrounding their PA; behavior occurs to meet intrinsic goals developed by the self (Aelterman et al., 2016; De Meester et al., 2017; Gillison et al., 2014; Kerner &

Goodyear, 2017). Aelterman et al., (2016) found that autonomy-supportive environments yielded the most desirable patterns of outcomes with the highest levels of learning and performance and the lowest levels of resentment. Schneider and Kwan (2013) were able to demonstrate that autonomous motivation may be enhanced when the environment supports the needs of autonomy, competence, and relatedness, and in which adolescents participate in activities that they enjoy. An environment that provides support for these needs move motivation along the continuum in a positive direction (Gillison et al., 2009; Mouratidis & Michou, 2011). Parents, PE teachers, peers, coaches and other adults or youth role models can develop autonomy-supportive environments (Gillison et al., 2013; Jõesaar et al., 2012).

Autonomy. Adolescents need to feel they have a choice in the PA behavior they participate in (Fullmer et al., 2018; Nicaise & Kahan, 2013). Gaudreau et al. (2016) demonstrated an autonomy-supportive environment created by parents and coaches increased PA. Their autonomy-supportive environment allowed for adolescent athletes to express their feelings, priorities, and values related to their sport and have autonomy related to their activity (Gaudreau et al., 2016). Athletes who had strong support from their parents and coaches had more safeguard from decreases in their motivation towards their sports than those who perceived low levels of support from coaches or parents (Gaudreau et al., 2016).

Competence. The autonomy-supportive environment that the adolescent is participating in can contribute to the competence an adolescent feels regarding PA. For example, coaches, parents, and peers are all social agents who can contribute to an adolescent feeling more competent in his or her PA through verbal encouragement and role modeling behavior (Fullmer et al., 2018; Gillison, et al., 2011). Adolescents will be motivated for PA if they feel they can be successful at the task; without this component being present, they will feel as if they cannot even

start the task (Fullmer et al., 2018; Gillison, et al., 2011). Ensuring that PA begins with easier skills, and then advances to more difficult skills, will help support the development of competency towards PA which in turn supports autonomous motivation. Competency with skills can be developed through observation as well as active involvement in the skills (Shen, 2014).

Relatedness. Developing a sense of relatedness is another important part of an autonomy-supportive environment and enhances autonomous motivation (Fullmer et al., 2018; Gillison et al., 2011). Adolescents are seeking new identities that support their own interests and want to feel that they belong with others who share in those same interests. Results from previous studies related to social support have indicated a need for continued research on social support as a predictor of PA among adolescents in order to specifically identify the type of social support needed to increase their PA (Draper et al., 2015; Laird et al., 2016; Mendonca et al., 2014). Peers, parents, and others are instrumental in emotional and social support or encouragement, such as financial support for transportation, and clothes or equipment for PA participation (McDavid et al., 2012; Peterson et al., 2013). Participation in youth sports and organized clubs can also influence adolescent PA in a positive way when an autonomy-support environment is present in the environment (Li et al., 2014).

In contrast, an environment that does not support the adolescent's need for autonomy-support is called a controlled environment (Ryan & Deci, 2017). Behaviors are less likely to be maintained in a controlled environment because they do not support the individual's psychological needs (Fenton et al., 2014; Mouratidis & Michou, 2011). An adolescent may participate in PA to avoid punishment or to receive a reward, but the motivation will not be autonomous and may not contribute to long-term behavioral change.

Positive Perceptions of PA. Adolescents also need to have positive perceptions of PA; adolescents need to perceive that PA is fun and enjoyable, that PA is a part of who they are (Dishman et al., 2018; Li et al., 2014) or perceive that it is important to them. These positive perceptions can positively influence their autonomous motivation for PA (Fenton et al., 2014; McDavid et al., 2012; McDavid et al., 2014; Power et al., 2011). Adolescents can accurately evaluate their own self-competence and perceptions of peer evaluation becomes increasingly important. Due to the physical changes occurring during puberty, self-consciousness is high which can impact the perceptions of competence related to PA (Gillison et al., 2009) and the degree to which adolescents perceive themselves as being athletic or capable of participating successfully in PA.

Consequences

Greater Physical Activity. The primary consequence of adolescent autonomous motivation for PA is greater PA among adolescents. Secondary consequences from an increase in PA include academic success (WHO, 2018), improved interpersonal relationships with others (Ullrich-French & Smith, 2006), positive body image (Gillison et al., 2011), decreased screen time and use of technology (WHO, 2018), and long-term health outcomes such as decreased body mass index and percent body fat, increased cardiorespiratory fitness, increased well-being, and quality of life (WHO, 2018). Additionally, improvements in PA may delay or prevent adverse health outcomes such as obesity, diabetes, hypertension and hyperlipidemia (CDC, 2017). Autonomous motivation for PA leads to greater PA among adolescents (Nicaise & Kahan, 2013; Owen et al., 2013). Table 2.5 lists the examples of increased PA found in the literature. Several interventions that have improved PA in the PE environment have demonstrated that it is essential to address the antecedents of autonomous motivation in order to promote PA among

adolescents (Nicaise & Kahan, 2013; Owen et al., 2013). Autonomous motivation for PA outside the PE environment is essential for adolescents to continue to be physically active during leisure time. Continued research is needed to determine the best ways to achieve this objective.

Table 2.5: Analysis of consequences of motivation related to adolescent physical activity

Consequences	Characteristics (sources)
Greater physical activity	Self-determined motivation may be an effective means of ensuring that PE programs are able to increase PA levels, foster self-initiated PA behaviors, and enhance adolescents' health (Lonsdale et al. 2009)
	Positive profile had higher ($p < .01$) perceived autonomy, relatedness, self-determined motivation, enjoyment, effort and value compared to the others, both the positive and mixed profiles experienced less ($p < .05$) worry, higher perceptions of competence and physical activity (Cox et al. 2010).
	Autonomous motivation and need satisfaction positively predicted exercise maintenance in both genders (Gillison et al. 2011)
	Psychological need satisfaction was positively associated with intrinsic and identified motivation types and intrinsic motivation was positively associated with children's minutes in MVPA (Sebire et al. 2013).
	Self-determined motivational behavior was associated with PA change on both PE & non-PE days (Nicaise et al. 2013).
	Motivation is an important correlate of adolescent boys MVPA in PE lessons and leisure time PA (Owen et al. 2013).
	Adolescents with higher internal motivation and more active friends were more likely to engage in MVPA (Li et al. 2014).
	Autonomous motivation was positively associated with MVPA, and negatively related to sedentary time (min/day), (Fenton et al. 2014).
	The results confirmed that the autonomously motivated profile yielded the most desirable pattern of outcomes, as indexed by the highest levels of learning and performance and the lowest levels of resentment (Aelterman et al. 2016).
	Self-determined behavior regulation and competence were positively associated with PA & health (Craike et al. 2014).
	Targeted physical activity programs for adolescent boys may have utility for mental health promotion through the mechanisms of increasing autonomy support and muscular fitness and reducing screen time (Lubans et al. 2016).

Conceptual Definition

Based on the defining attributes, antecedents, and consequences that were established from the literature, the authors defined adolescent autonomous motivation for PA as: Adolescent autonomous motivation for PA is a personal desire to attain PA because the behavior is fun and enjoyable, or it is an important part of how the adolescent self-identifies. The adolescent views the self as being healthy so maintains a healthy lifestyle; or views the self as athletic so needs to attain adequate MVPA. It is important that researchers are consistent in the use of terminology and clarify the types of motivation being examined.

Exemplar of the Concept

An exemplar of the concept provides a comprehensive description of adolescent autonomous motivation for PA (Toftagen & Fagerström, 2010). For example, a 15-year-old adolescent male visited the school nurse's office and reported recent poor academic success and poor-quality relationships. He indicated that he was tired because he stays up late at night playing video games. The nurse found that the adolescent was on video games for greater than the recommended two hours a day and lacked any PA, even though he had positive experiences participating in team sports throughout childhood (dynamic). The school nurse discusses the importance of PA with the adolescent and he recognizes the benefit and value of PA (continuum; identified). The school nurse worked with the student to develop a plan that would help him achieve success. The plan focused on decreasing the time spent playing video games and increasing the time in PA that he might enjoy engaging in 2-3 times a week (positive perception of PA) – in his leisure time. Fortunately, the school nurse was aware that local YMCA (autonomy-supportive environment) offered a variety of PA programs at a low cost for adolescents. The programs focused on building skills for PA (competence) to help adolescents

choose (autonomy) what they enjoy and want to do to stay active after school and on weekends. A key component of the programs involved forming positive relationships with others (relatedness; autonomy-supportive environment). The school nurse and the student developed a goal to have the student get involved in a YMCA program and addressed his reason for wanting to participate – he sees himself as a healthy adolescent (continuum; integrated). The student gave the school nurse permission to discuss the possibility with his parents. The parents agreed that they were interested in this opportunity to help their son establish a healthy lifestyle. The school nurse, program instructors, his peers and his parents all provided positive encouragement, and supported him throughout the process (autonomy-supportive environment). The school nurse and the student talked about the skills he learned and the PAs he enjoyed. The student agreed that when he is participating in the PA, he feels confident in his skills (competence; positive perceptions of PA), that he feels as if he is part of the group when he is participating (relatedness; positive perceptions of PA). He even found two new friends through the program who were also interested in similar PAs and could participate with him. The nurse followed up with the student and parents and received positive feedback including increased PA, he feels PA is fun, interesting and he enjoys it (continuum; intrinsic), greater academic success, and positive relationships with peers, adults, and family members after increasing his PA level (consequences).

In this example, the student experienced the antecedents of an autonomy-supportive environment and positive perceptions of PA so he could participate in PA. He had the attributes of autonomous motivation for PA being on a continuum and being dynamic. He experienced the positive outcomes associated with increased PA.

Discussion

The authors utilized Rodgers (2000) Evolutionary Method for this concept analysis of adolescent autonomous motivation for PA. The analysis indicated that adolescent autonomous motivation of PA is reflected by a continuum and is dynamic, (De Meester et al., 2017; Dishman et al., 2018; Wang, 2017). Adolescent autonomous motivation for PA may include intrinsic motivation and two forms of extrinsic motivation, integrated and identified behavioral regulations. The bidirectional movement of adolescent autonomous motivation for PA is based on the social context and autonomy-supportive environment providing support for or hindering its development (Fullmer et al., 2018; Gillison et al., 2011). During adolescence these environments can change frequently, and adolescents are still developing the domains of development that will be important for them. In addition, the positive perceptions of PA impact their autonomous motivation for PA. Rodgers Evolutionary Method (2000) was helpful for guiding the analysis of adolescent autonomous motivation for PA, a concept that changes over time. Because Ryan and Deci's (1985) Self-Determination theory emphasizes autonomous motivation, it was able to provide a strong foundation on which to build the analysis of this concept. Challenges of this analysis included the lack of consistency in the literature related to the following terms: "motivation", "autonomous motivation", and "types of regulation".

In the literature, there were several operational measurements found. One instrument used to measure the multi-dimensions of motivation (i.e., intrinsic, extrinsic and amotivation) is the Behavioral Regulation in Exercise Questionnaire (BREQ)-3 (Markland & Tobin, 2004; Wilson et al., 2006); an updated version of the BREQ and BREQ2. Earlier versions of the BREQ included limited dimensions of motivation. The BREQ-3 is comprised of one intrinsic subscale and the following four extrinsic subscales: integrated, identified, introjected, and amotivation.

Unfortunately, the scale does not offer a clear score for measuring autonomous motivation. Recommendations for using the BREQ-3 include calculating separate scores for each subscale (Chemolli & Gagne, 2014). To obtain a score for autonomous motivation, researchers have inconsistently combined the dimensions of intrinsic motivation with either one or two of the dimensions of the extrinsic regulation (specifically, identified, and integrated).

Wang (2017) used the Relative Autonomy Index (RAI) to calculate autonomous motivation which is a single score derived from the subscales that gives an index of how self-determined the person feels. Dishman et al. (2018) used intrinsic, integrated, and identified regulation to measure autonomous motivation, and DeMeester et al. (2017) used an adapted version of the BREQ-2 selecting 8 items to represent autonomous motivation (Dishman et al., 2018; DeMeester et al., 2017; Wang, 2017). Other instruments were also found that measured autonomous motivation including the: Sport Motivation Scale (Timo et al., 2016), Basic Psychological Needs in Exercise Scale (Sicilia et al., 2016), and the Perceived Locus of Causality Scale (McDavid et al., 2014). These instruments provided separate scores for the different types of motivation; however, a score for autonomous motivation was not noted. In theory, autonomous motivation is purported to be associated with behavioral change (Fenton et al., 2014). Clarity is needed regarding the concept so that its relationship to a behavior, such as PA, can be accurately and consistently assessed. When measuring autonomous motivation, utilizing a consistent measurement tool, such as the BREQ3, that has been developed specifically for this purpose is important. Researchers need to include the same types of extrinsic motivation, integrated and identified, in the measure so that the results can be compared.

Of the reviewed studies, only two employed a mixed-method approach (Gillison et al., 2012; Kerner & Goodyear, 2017), and less than 15% ($n=7$) were qualitative. Using a qualitative

or mixed-methods approach may enhance the understanding of adolescent autonomous motivation for PA by eliciting adolescents' perspectives. These types of studies could offer an in-depth understanding of the perspectives and life experiences of adolescents who are physically active compared to those who are not. In addition, studies collected information on PA outcomes through self-report as well as objectively measured PA. Utilizing an objective measure of PA for accuracy is also important when reporting other outcomes linked to autonomous motivation.

Investigating how autonomous motivation for PA differs among diverse groups of adolescents may provide additional insight for developing interventions aimed at increasing their autonomous motivation for PA (Dishman et al., 2018). For instance, an intervention that focuses on facilitating a sense of competence and achievement may be more important for healthy-weight females in early adolescence that may build confidence (Gillison et al., 2012). Rather than an intervention that centers on giving choice and building friendships with males in early adolescence (Lubans et al., 2016). Efforts to understand these differences may lead to improvements in tailoring interventions to meet the needs of diverse groups of adolescents. Although this analysis has provided a conceptual definition of adolescent autonomous motivation for PA, future research should be directed toward continued refinement of the definition. In addition, future researchers need to be consistent in the use of the term and clarify the types of motivation being researched. This concept analysis is expected to enhance nurses' and other health care providers' knowledge related to adolescent autonomous motivation for PA.

Limitations

Due to the existing limited number of qualitative studies, this concept analysis may not fully reflect adolescents' own perspectives. In addition, the differences between objectively

measured PA outcomes and self-reported PA outcomes may not be comparable for autonomous motivation because of the differences in reporting.

Conclusions

We examined adolescent autonomous motivation for PA. Key findings from the analysis of this concept are that an autonomy-supportive environment is important and positive perceptions of PA need to be considered. In addition, the concept of adolescent autonomous motivation for PA is dynamic and on a continuum. The information serves to clarify the concept, which may be helpful for promoting consistency of measurement across professional disciplines. Future research with adolescents is warranted to examine underlying differences in autonomous motivation for PA that may exist by age, sex, weight status, and developmental stage.

Attaining regular and adequate PA not only prevents chronic conditions, such as diabetes, heart disease, and cancer, but also helps adolescents to develop positive relationships, maintain emotional wellness, and achieve academic success. Establishing regular and adequate PA during adolescence is important for the continuation of behaviors later in life. Adolescents who maintain healthy behaviors have an increased chance of becoming healthy adults who can contribute to society in a positive way. This concept analysis provides information about adolescent autonomous motivation that is important to consider when designing interventions to increase adolescent PA.

REFERENCES

- Aelterman, N., Vansteenkiste, M., Soenens, B., & Haerens, L. (2016). A dimensional and person-centered perspective on controlled reasons for non-participation in physical education. *Psychology of Sport Exercise*, 23, 142-154. doi.org/10.1016/j.psychsport.2015.12.001
- Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology of Health*, 26(9), 1113-1127. doi:10.1080/08870446.2011.613995
- American Psychological Association (2018). Stress in America: Stress and Current Events. Stress in America™ Survey
- Bengoechea, E., & Streat, W. (2007). On the interpersonal context of adolescents' sport motivation. *Psychology of Sport & Exercise*, 8(2), 195-217. doi.org/10.1016/j.psychsport.2006.03.004
- Boiché, J., & Sarrazin, P. (2007). Self-determination of contextual motivation, inter-context dynamics and adolescents' patterns of sport participation over time. *Psychology of Sport Exercise*, 8(5), 685-703. doi:10.1016/j.psychsport.2006.10.004
- Centers for Disease Control and Prevention. (n.d.). Gateway to health communication & social marketing impact (2017).
<https://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/PhysicalInactivity.html>
- Charrois T. (2015). Systematic reviews: What do you need to know to get started? *The Canadian Journal of Hospital Pharmacy*, 68(2), 144–148. doi:10.4212/cjhp.v68i2.1440
- Chemolli, E., & Gagne, M. (2014). Evidence against the continuum structure underlying motivation measures derived from self-determination theory. *Psychological Assessment*, 26(2), 575-585. doi:10.1037/a0036212
- Cox, A. E., & Ullrich-French, S. (2010). The motivational relevance of peer and teacher relationship profiles in physical education. *Psychology of Sport & Exercise*, 11(5), 337-344. doi.org/10.1016/j.psychsport.2010.04.001
- Craike, M., Polman, R., Eime, R., Symon, C., Harvey, J., & Payne, W.. (2014). Associations between behavior regulation, competence, physical activity, and health for adolescent females. *Journal of Physical Activity and Health*, 11(2), 410-418. doi.org/10.1123/jpah.2012-0070
- De Meester, A., Cardon, G., DeBourdeaudhuij, I., & Haerens, L.(2017). Extracurricular school-based sports as a stepping stone toward an active lifestyle? Differences in physical activity and sports-motivation between extracurricular school-based sports participants and non-participants. *Journal of Teaching in Physical Education* 36(4), 485-497. doi.org/10.1123/jtpe.2016-0035

- Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self determination in human behavior*. Rochester, NY: Plenum Press.
- Deci, E., and Ryan, R. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, 49(3), 182-5. doi.org/10.1037/a0012801
- Debate, R., Huberty, J., & Pettee, K. (2009). Psychometric properties of the commitment to physical activity scale. *American Journal of Health Behavior*, 33(4), 425-434. doi:10.5993/AJHB.33.4.8
- Dishman, R., McIver, K., Dowda, M., Saunders, R. & Pate, R. (2015). Motivation and behavioral regulation of physical activity in middle school students. *Medicine & Science in Sports & Exercise*, 47(9), 1913-1921. doi.10.1249/MSS.00000000000000616
- Dishman, R., McIver, K., Dowda, M., & Pate, R. (2018). Declining physical activity and motivation from middle school to high school. *Medicine & Science in Sports & Exercise*, 50(6), 1206-1215. doi:10.1249/MSS.0000000000001542
- Dobbins, M., Husson, H., DeCorby, K., & LaRocca, R. (2013). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews*, (2). doi: 10.1002/14651858.CD00765
- Draper, C., Grobler, L., Micklesfield, L., & Norris, S. (2015). Impact of social norms and social support on diet, physical activity and sedentary behaviour of adolescents: A scoping review. *Child: Care, Health & Development*, 41(5), 654-667. doi:10.1111/cch.12241
- Fenton, S., Duda, J., Quested, E., & Barrett, T. (2014). Coach autonomy support predicts autonomous motivation and daily moderate-to-vigorous physical activity and sedentary time in youth sport participants. *Psychology of Sport Exercise*, 15(5), 453-463. doi.org/10.1016/j.psychsport.2014.04.005
- Ferriz, R., Gonzalez-Cutre, D., Sicilia, A., & Hagger, M. (2016). Predicting healthy and unhealthy behaviors through physical education: A self-determination theory-based longitudinal approach. *Scandinavian Journal Medical Science Sports*, 26(5), 579-592. doi:10.1111/sms.12470
- Fullmer, M., Wilkinson, C., Prusak, K., Eggett, D., & Pennington, T. (2018). Adolescent physical activity and motivational profiles while keeping a physical activity record. *Journal of Teaching in Physical Education*, 37(1), 1-11. doi.org/10.1123/jtpe.2017-0072
- Gaudreau, P., Morinville, A., Gareau, A., Verner-Filion, J., Green-Demers, I., Franche, V. (2016). Autonomy support from parents and coaches: Synergistic or compensatory effects on sport-related outcomes of adolescent-athletes? *Psychology of Sport Exercise*, 25, 89-99. doi.org/10.1016/j.psychsport.2016.04.006

- Gillison, F., Sebire, S., Standage, M. (2012). What motivates girls to take up exercise during adolescence? Learning from those who succeed. *British Journal of Health Psychology*, 17(3), 536-550. doi: 10.1111/j.2044-8287.2011.02053
- Gillison, F., Standage, M., & Verplanken, B. (2014). A cluster randomised controlled trial of an intervention to promote healthy lifestyle habits to school leavers: Study rationale, design, and methods. *BMC Public Health*, 14(1), 221-221. doi: 10.1186/1471-2458-14-221
- Gillison, F., Standage, M., & Skevington, S. (2011). Motivation and body-related factors as discriminators of change in adolescents' exercise behavior profiles. *Journal of Adolescent Health*, 48(1), 44-51. doi: 10.1016/j.jadohealth.2010.05.006
- Gillison, F., Standage, M., & Skevington, S. (2013). The effects of manipulating goal content and autonomy support climate on outcomes of a PE fitness class. *Psychology of Sport Exercise*, 14(3), 342-352. doi:10.1016/j.psychsport.2012.11.011
- Gillison, F., Osborn, M., Standage, M., & Skevington, S. (2009). Exploring the experience of introjected regulation for exercise across gender in adolescence. *Psychology of Sport & Exercise*, 10(3), 309-319. doi: 10.1016/j.psychsport.2008.10.004
- Gunnell, K., Bélanger, M., & Brunet, J. (2016). A tale of two models: Changes in psychological need satisfaction and physical activity over 3 years. *Health Psychology*, 35(2), 167-177. doi:10.1037/hea0000259
- Hassandra, M., Goudas, M., & Chroni, S. (2003). Examining factors associated with intrinsic motivation in physical education: A qualitative approach. *Psychology of Sport & Exercise*, 4(3), 211-223. doi:10.1016/S1469-0292(02)00006-7
- Healthy People 2020. Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, <https://www.healthypeople.gov/2020/topics-objectives/topic/Adolescent-Health>
- Hruby, A., & Hu, F. B. (2015). The epidemiology of obesity: A big picture. *Pharmacoeconomics*, 33(7), 673–689. <https://doi.org/10.1007/s40273-014-0243-x>
- Hwang, J., & Kim, Y. (2013). Physical activity and its related motivational attributes in adolescents with different BMI. *International Journal of Behavioral Medicine*, 20(1), 106-113. doi:10.1007/s12529-011-9196-z
- Jarvis, C. (2019). Physical examination and health assessment (8th ed.). Philadelphia: Elsevier.
- Jõesaar, H., Hein, V., & Hagger, M. (2011). Peer influence on young athletes' need satisfaction, intrinsic motivation and persistence in sport: A 12-month prospective study. *Psychology of Sport and Exercise*, 12(5), 500-508. doi:10.1016/j.psychsport.2011.04.005

- Jõesaar, H., Hein, V., & Hagger, M. (2012). Youth athletes' perception of autonomy support from the coach, peer motivational climate and intrinsic motivation in sport setting: One-year effects. *Psychology of Sport Exercise* 13(3), 257-262. doi.org/10.1016/j.psychsport.2011.12.001
- Karagiannidis, Y., Barkoukis, V., Gourgoulis, V., Kosta, G., & Antoniou, P. (2015). The role of motivation and metacognition on the development of cognitive and affective responses in physical education lessons: A self-determination approach. *Motricidade*, 11(1), 135-150. doi:10.6063/motricidade.3661
- Kerner, C., & Goodyear, V. (2017). The motivational impact of wearable healthy lifestyle technologies: A self-determination perspective on fitbits with adolescents. *American Journal of Health Education*, 48(5), 287-297. doi: 10.1080/1932503712017.1343161
- Kwan, B., Stevens, C., & Bryan, A. (2017). What to expect when you're exercising: An experimental test of the anticipated affect-exercise relationship. *Health Psychology*, 36(4), 309-319. doi:10.1037/hea0000453
- Laird, Y., Fawkner, S., Kelly, P., McNamee, L., & Niven, A. (2016). The role of social support on physical activity behaviour in adolescent girls: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition & Physical Activity*, 13, 1-14. doi:10.1186/s12966-016-0405-7
- Li, K., Iannotti, R., Haynie, Z., Perlus, J., & Simons-Marto, B. (2014). Motivation and planning as mediators of the relation between social support and physical activity among U.S. adolescents: A nationally representative study. *International Journal of Behavior Nutrition Physical Activity* 11(1), 42. doi.org/10.1186/1479-5868-11-42
- Lonsdale, C., Sabiston, C., Raedeke, T., Ha, A., & Sum, R. (2009). Self-determined motivation and students' physical activity during structured physical education lessons and free choice periods. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 48(1), 69-73. doi:10.1016/j.ypmed.2008.09.013
- Lubans, D., Smith, J., Morgan, P., Beauchamp, M., Miller, A., Lonsdale, C., . . . Dally, K. (2016). Mediators of psychological well-being in adolescent boys. *Journal of Adolescent Health*, 58(2), 230-236. doi:10.1016/j.jadohealth.2015.10.010
- Markland, D., & Tobin, V. (2004). A modification of the behavioral regulation in exercise questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*, 26(2), 191-196. doi:10.1123/jsept.26.2.191
- Markland, D., & Ingledew, D. (2007). The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females. *Psychology of Sport Exercise*, 8(5), 836-853. doi:10.1016/j.psychsport.2006.11.002

- McDavid, L., Cox, A., & McDonough, M. (2014). Need fulfillment and motivation in physical education predict trajectories of change in leisure-time physical activity in early adolescence. *Psychology of Sport Exercise*, 15(5), 471-480. doi.org/10.1016/j.psychsport.2014.04.006
- McDavid, L., Cox, A., & Amorose, A. (2012). The relative roles of physical education teachers and parents in adolescents' leisure-time physical activity motivation and behavior. *Psychology of Sport Exercise*, 13(2), 99-107. doi: 10.1016/j.psychsport.2011.10.003
- Mendonça, G., Cheng, L., Mélo, E., & de Farias Júnior, J. (2014). Physical activity and social support in adolescents: A systematic review. *Health Education Research*, 29(5), 822-839. doi:her/cyu017
- Minatto, G., Barbosa Filho, V., Berria, J., & Petroski, E. (2016). School-based interventions to improve cardiorespiratory fitness in adolescents: Systematic review with meta-analysis. *Sports Medicine*, 46(9), 1273-1292. doi:10.1007/s40279-016-0480-6
- Mouratidis, A. & A. Michou (2011). Perfectionism, self-determined motivation, and coping among adolescent athletes. *Psychology of Sport & Exercise*, 12(4), 355-367. doi: 10.1016/j.psychsport.2011.03.006
- Murdaugh, C., Parsons, M., & Pender, N., (2019). Health promotion in nursing practice (8th ed.). Upper Saddle River, N.J.: Pearson.
- Niemiec, C., & Ryan, R. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and Research in Education*, 7(2), 133-144.
- Nicaise, V. & Kahan, D. (2013). Psychological changes among muslim students participating in a faith-based school physical activity program. *Research Quarterly for Exercise & Sport*, 84(4), 522-529.
- O'Loughlin, E., Sabiston, C., Dugas, E., & O'Loughlin, J. (2015). The association between exercise behavior regulation and exergaming in adolescents. *Journal of Physical Activity & Health*, 12(3), 328-334. doi: 10.1123/jpah.2012-0455
- Owen, K., Smith, J., Lubans, D., Ng, J., & Lonsdale, C. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive Medicine*, 67, 270-279. doi:10.1016/j.ypmed.2014.07.033
- Owen, K., Astell-Burt, T., & Lonsdal, C. (2013). The relationship between self-determined motivation and physical activity in adolescent boys. *Journal of Adolescent Health*, 53(3), 420-422. doi.org/10.1016/j.jadohealth.2013.05.007

- Owen, M., Curry, W., Derner, G., Newson, L., & Fairclough, S. (2017). The effectiveness of school-based physical activity interventions for adolescent girls: A systematic review and meta-analysis. *Preventive Medicine, 105*, 237-249. doi: 10.1016/j.ypmed.2017.09.018
- Peterson, M., Lawman, H., Wilson, D., Fairchild, A., & Van Horn, M. (2013). The association of self-efficacy and parent social support on physical activity in male and female adolescents. *Health Psychology, 32*(6), 666-674. doi:10.1037/a0029129
- Piercy, K., Troiano, R., & Ballard, R., et al. (2018). The Physical Activity Guidelines for Americans. *JAMA*.2018;320(19), 2020–2028. doi:10.1001/jama.2018.14854
- Power, T., Ullrich-French, S., Steele, M., Daratha, K., & Bindler, R. (2011). Obesity, cardiovascular fitness, and physically active adolescents' motivations for activity: A self-determination theory approach. *Psychology of Sport Exercise, 12*(6), 593-598. doi.org/10.1016/j.psychsport.2011.07.002
- President's Council on Fitness, Sports and Nutrition. Facts and Statistics (n.d.). (2017) <https://www.hhs.gov/fitness/resource-center/facts-and-statistics/index.html>
- Richards, E. (2015). The evolution of physical activity promotion. *American Journal of Nursing, 115*(8), 50-54. doi:10.1097/01.NAJ.0000470400.28683.97
- Robbins, L., Jiying, L., Wesolek, S., Kazanis, A., Bourne, K., Resnicow, K., & Ling, J. (2017). Reliability and validity of the commitment to physical activity scale for adolescents. *American Journal of Health Promotion, 31*(4), 343-352. doi:10.4278/ajhp.150114-QUAN-665
- Rodgers B. (2000). Concept analysis: An evolutionary view. *Concept Development in Nursing: Foundations, Techniques and Applications*, 2nd edn (Rodgers, B.I. & Knafl K.A., eds), iSaunders, Philadelphia, PA, pp. 77-102.
- Ryan, R., & Deci, E. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25*. doi: 10/1006/ceps.1999.1020
- Ryan, R., & Deci, E. (2017). *Self-Determination theory. Basic psychological needs in motivation, development and wellness*. Guilford Press, New York, London.
- Schneider, M. & Kwan, B. (2013). Psychological need satisfaction, intrinsic motivation and affective response to exercise in adolescents. *Psychology of Sport Exercise, 14*(5), 776-785. doi: 10.1016/j.psychsport.2013.04.005
- Sebire, S., Jago, R., Fox, K., Edwards, M., & Thompson, J. (2013). Testing a self-determination theory model of children's physical activity motivation: A cross-sectional study. *International Journal of Behavior Nutrition Physical Activity, 10*, 111. doi:10.1186/1479-5868-10-111

- Shen, B. (2014). Outside-school physical activity participation and motivation in physical education. *British Journal of Education Psychology*, 84(1), 40-57. doi:10.1111/bjep.12004
- Sicilia, Á., Sáenz-Alvarez, P., Wgonzález-Cutre, D., & Ferriz, R. (2016). Social physique anxiety and intention to be physically active: A self-determination theory approach. *Research Quarterly for Exercise & Sport*, 87(4), 354-364. doi:10.1080/02701367.2016.1213351
- Silva, M., Vieira, P., Coutinho, S., Minderico, C., Matos, M., Sardinha, L., & Teixeira, P. (2010). Using self-determination theory to promote physical activity and weight control: A randomized controlled trial in women. *Journal of Behavioral Medicine*, 33(2), 110-122. doi:10.1007/s10865-009-9239-y
- Singh, R. (2016). The impact of intrinsic and extrinsic motivators on employee engagement in information organizations. *Journal of Education for Library & Information Science*, 57(2), 197-206. doi:10.12783/issn.2328-2967/57/2/11
- Sterdt, E., Liersch, S., & Walter, U. (2014). Correlates of physical activity of children and adolescents: A systematic review of reviews. *Health Education Journal*, 73(1), 72-89. doi:10.1177/0017896912469578
- Timo, J., Sami, Y., Anthony, W., & Jarmo, L. (2016). Perceived physical competence towards physical activity, and motivation and enjoyment in physical education as longitudinal predictors of adolescents' self-reported physical activity. *Journal of Science & Medicine in Sport*, 19(9), 750-754. doi: 10.1016/j.jsams.2015.11.003
- Toftthagen, R. & Fagerstrom, L. (2010). Rodgers' evolutionary concept analysis- A valid method for developing knowledge in nursing science. *Scandanavian Journal of Caring Sciences*, 24. doi: 10.1111/j.1471-6712.2010.00845
- Troiano R., Berrigan D., Dodd KW, Masse LC, Tilert T, McDowell M. (2008). Physical activity in the United States measured by accelerometer. *Medical Science Sports Exercise*, 40(1):181-188.
- Ullrich-French, S., & Smith, A. (2006). Perceptions of relationships with parents and peers in youth sport: Independent and combined prediction of motivational outcomes. *Psychology of Sport & Exercise*, 7(2), 193-214. doi.org/10.1016/j.psychsport.2005.08.006
- Vansteenkiste, M., Matos, L., Lens, W., & Soenens, B. (2007). Understanding the impact of intrinsic versus extrinsic goal framing on exercise performance: The conflicting role of task and ego involvement. *Psychology of Sport Exercise*, 8(5), 771-794. doi: 10.1016/j.psychsport.2006.04.006
- Vierling, K., Standage, M., & Treasure, D. (2007). Predicting attitudes and physical activity in an "at-risk" minority youth sample: A test of self-determination theory. *Psychology of Sport Exercise*, 8(5), 795-817. doi.org/10.1016/j.psychsport.2006.12.006

- Wang, L. (2017). Using the self-determination theory to understand Chinese adolescent leisure-time physical activity. *European Journal of Sport Science*, 17(4), 453-461. doi.org/10.1080/17461391.2016.1276968
- Whalen, L., McCaughtry, N., Garn, A., Kulik, N., Centeio, E., Maljak, K., . . . Martin, J. (2016). Why inner-city high-school students attend after-school physical activity clubs. *Health Education Journal*, 75(6), 639-651. doi.org/10.1177/0017896915608885
- Williams, L. (2013). Commitment to sport and exercise: Re-examining the literature for a practical and parsimonious model. *Journal of Preventative Medicine and Public Health*, 46(1), 35-42. doi: 10.3961/jpmph.2013.46.S.S35
- Wilson, D., Evans, A., Williams, J., Mixon, G., Sirard, J., & Pate, R. (2005). A preliminary test of a student-centered intervention on increasing physical activity in underserved adolescents. *Annals of Behavioral Medicine*, 30(2), 119-124. doi:10.1207/s15324796abm3002_4
- Wilson, P., Rodgers, W., Loitz, C., & Scime, G. (2006). "It's who I am...really!" The importance of integrated regulation in exercise contexts. *Journal of Biobehavioral Research*, 11, 79-104. doi: 10.1111/j.1751-9861.2006.tb00021.x
- World Health Organization (2018). Global strategy on diet, physical activity and health. http://www.who.int/dietphysicalactivity/factsheet_young_people/en/.

CHAPTER 3: FEASIBILITY, ACCEPTABILITY, AND PRELIMINARY EFFICACY OF
TEEN LEISURE TIME PHYSICAL ACTIVITY CLUB: A PHYSICAL ACTIVITY
INTERVENTION FOR RURAL, HIGH SCHOOL STUDENTS

Abstract

Background: Inadequate physical activity (PA) is prevalent among high school (HS) students, and increases risk for chronic health conditions. Interventions are needed to address this problem.

Objective: The purpose of this study was to evaluate the feasibility, acceptability, and preliminary efficacy of a 10-week Teen Leisure Time Physical Activity Club (TLC) intervention among rural HS students, compared to a control condition (usual after-school activities).

Method: A non-equivalent group design was used with a convenience sample of 31 HS students, in grades 9-12. A school with higher enrollment into the study received the intervention, and the other served as the control. The intervention included invitations to two face-to-face PA events, receipt of daily Self-Determination Theory (SDT) - based avatar messages, and forwarding the messages to other participants up to four times, and receipt of weekly PA goals, and strategies from a club mascot. At baseline and post-intervention, participants completed questionnaires assessing demographics, PA, Basic Psychological Needs (BPNs), motivation for PA, and perceived stress. PA and sedentary behavior were estimated via accelerometers. Height, weight, and percent body fat (% BF) were measured.

Results: Enrollment rate was low (1.88%), but retention rate was high (83%) and feedback from participants was positive. No significant between-group differences occurred in any of the outcomes. However, according to the effect sizes, the intervention had a large effect in decreasing sedentary behavior ($\eta_p^2=.22$) and improving integrated motivation ($\eta_p^2=.20$) and

autonomy ($\eta_p^2=.38$). Moreover, the effects in reducing %BF ($\eta_p^2=.12$) and increasing MVPA ($\eta_p^2=.13$), relatedness ($\eta_p^2=.10$), autonomy-supportive environment ($\eta_p^2=.12$) and self-reported PA ($\eta_p^2=.13$) were moderate.

Discussion: The findings of a high retention rate and high instructor and participant satisfaction support the feasibility and acceptability of applying after-school PA club and avatar messages to promote PA among HS students. The lack of significant effects may be due to the brief intervention length, participant's levels of PA at baseline, and small sample size. In the future, strategies are needed to effectively recruit HS students into a PA study, and to address challenges associated with wearing an ActiGraph.

Keywords: adolescents, physical activity, intervention, rural

INTRODUCTION. Of 15.3 million HS students in the United States (US), 15.5% are obese and 16.1% are overweight (Youth Risk Behavior Survey, 2019), and many are at risk for chronic health conditions (Guthold et al., 2020; President’s Council on Fitness, Sports and Nutrition, 2017). Even more disconcerting is a more recent report of 2017-2020 National Health and Nutrition Examination Survey data shows 25.6% of 12-19 years old are obese (Hu & Staiano, 2022). Increased Body Mass Index (BMI) and adiposity (e.g., percent body fat) are associated with decreased PA (Kelley, Kelley, & Pate, 2019). Eighty percent of adolescents do not meet guidelines calling for at least 60 minutes of mostly moderate-to-vigorous PA (MVPA) daily (Guthold et al., 2020; Piercy, Troiano, & Ballard, 2018). Adolescents in rural areas have 20.42 minutes/day more sedentary activity, and attain 8.17 minutes of MVPA/day less than urban adolescents (Euler et al, 2019). As a result, rural HS students, who comprise 15% of the US population, are at a higher risk for obesity. Adolescents should be targeted for obesity prevention interventions because their health habits have current and future health implications, and researchers can utilize the school environment to work with them, making adolescents an important group to target for improving health outcomes and developing effective interventions to increase PA (Smith, Fu, & Kobayashi, 2020).

Background. Previous interventions to increase HS students’ PA have involved physical education classes and school environmental change (Dudley et al., 2022; Pfledderer et al., 2021). Possibly due to a failure to assist HS students in developing autonomous motivation for PA, these approaches have not significantly improved HS students’ MVPA and its maintenance (Ntoumanis et al., 2021; Hynynen et al., 2016). Adolescent autonomous motivation for PA is the self-desire to be active because PA is fun, and enjoyable, or PA is part of how the adolescent maintains a healthy lifestyle and self-identifies (Palmer et al., 2020). As proposed by the SDT

autonomy-supportive environments can meet the basic psychological needs (BPNs) of competence, relatedness, and autonomy, enhance autonomous motivation, and increase PA (Ntoumanis et al., 2021; Owen et al., 2014). These BPNs must be satisfied in PA settings to be autonomously motivated to maintain PA (Ryan & Deci, 2017).

HS students who do not participate in physical education or after-school sport programs need alternative activities that can support their daily PA (Piercy et al, 2018; Pate, Flynn & Dowda, 2016;). No interventions were found that directly used autonomy-supportive environments in an after-school club to promote MVPA among rural HS students. To address this gap, this PA intervention, called TLC, targeted rural HS students and was designed to include autonomy-supportive elements.

The study was designed to determine (a) the feasibility of the intervention specifically related to the willingness of HS students to participate in each intervention component (b) acceptability and satisfaction perceived by club instructors, and (c) participants' level of satisfaction regarding each component. The secondary purpose of the study was to determine whether HS students in the intervention group showed greater improvement in BPNs and motivation for PA, as well as the health outcomes of MVPA, sedentary behavior, BMI, %BF, and perceived stress than those in the control group.

Methods. A non-equivalent group, two-group, quasi-experimental design with one intervention and one control school was used so that all participants in one location were in the same condition. The inclusion criteria were: 1) rural HS students enrolled in 9th-12th grades 2) available and willing to participate for 11 weeks, 3) spoke, read and understood English, and 4) had a working cell phone. Exclusion criteria included: 1) cognitive or learning impairment, and 2) diagnosis of a health condition that could have limited PA. *Procedures.* Prior to recruitment,

the school districts and the University Institutional Review Board provided approval to conduct the study. In fall 2021-2022, the researcher and research assistants visited students during their homeroom and distributed a flyer about the study with a QR code that connected to an electronic consent/assent form and screening tool. A parent email was sent by building administrators that explained the study and provided the link to the electronic consent/assent. A second recruitment was conducted by two trained student champions. Thirty-seven HS students (25 from intervention school; 12 from control school) who completed consent/assent forms were enrolled in the study.

Data were collected at baseline (0 weeks) and post-intervention (11 weeks). Data collectors were trained by the first author until competency was demonstrated. Participants were sent a Qualtrics link prior to the data collection event to complete surveys and were then compensated \$20. Table 3.1 lists the outcome measures and their reliability/validity. The researcher scheduled a time at each school for *anthropometric measurements*: BMI was calculated from weight and height, and %BF was measured using a Tanita Scale.

Table 3.1: Primary, Secondary Outcome Measures, Psychosocial Variables Measures (0 wks. & immediately post-intervention)

<i>Outcome/Variable</i>	<i>Measure</i>	
<i>Physical Activity (Primary Outcome)</i>	Accelerometer; ActiGraph (GT3X+ & GT3X-BT); Minutes of MVPA estimated from accelerometer recorded acceleration counts – 4 days of wear time; 8 hours per day	(Crouter et al., 2012, Hanggi et al., 2013, Romanzini et al., 2014, Santos-Lazano et al., 2013)
<i>Sedentary Behavior (Secondary Outcome)</i>	Accelerometer ActiGraph (GT3X+ & GT3X-BT); estimated from recorded acceleration counts – 4 days of wear time; 8 hours per day	(Crouter et al., 2012, Hanggi et al., 2013, Romanzini et al., 2014, Santos-Lazano et al., 2013)
<i>BMI (Secondary Outcome)</i>	Seca 214 Portable Stadiometer; (height & weight) Tanita Scale	

Table 3.1: (cont'd)

Outcome/Variable	Measure	Reliability/Validity
%BF (Secondary Outcome)	Seca 214 Portable Stadiometer;(%BF); Tanita Scale	
Perceived Stress (Secondary Outcome)	Perceived Stress Scale (ages 13-17; NIH, Kupst et al., 2015) rated 1 (never) to 5 (very often), 10 questions, (3 minutes)	α .89; CFI=.99; RMSEA=.06; (Kupst et al., 2015)
Autonomy- Supportive Environment	Perceived Autonomy Support Scale for Exercise Settings (PASSES), unidimensional scale; rated 1 (strongly disagree) to 7 (strongly agree), 12 questions, (3 mins.)	α =.995 (Hagger, et al., 2007)
Motivation for PA	Behavioral Regulation in Exercise Questionnaire (BREQ-3), multidimensional scale (utilize intrinsic, integrated, and identified for autonomous motivation); Response choices: (0) not true for me to (4) very true for me (24 items, 5 min.)	r = .23-.36, p =.01; α =.61-.88
Competence, Autonomy & Relatedness	BPNs in Exercise Scale, multidimensional scale; response choices: rating 1 (I don't agree at all) to 5 (I completely agree), (11 questions, 3 minutes)	Confirmatory factor analysis CFI = .936, RMSEA = .090 (90% CI = .074 – .105) (Vlachopoulos, Ntoumanis & Smith, 2010)

Feasibility was assessed by (a) enrollment rates: proportion of HS students invited who enrolled in the study, (b) retention rates: proportion of HS students who continued participation, (c) attendance rates: proportion of HS students who attended the two face-to-face TLC events and received daily motivational text messages, and weekly PA goals and PA strategy messages. Retention of $\geq 80\%$ and participation of $\geq 1/3$ of the participation demonstrated feasibility.

Acceptability and satisfaction were evaluated with questions assessing the club instructor's and participants' perceptions of the TLC club and individual interviews with intervention HS students. Overall mean instructor and participant satisfaction ratings > 3.0 (3 = agree a little; 4=agree a lot) indicated acceptable satisfaction.

Physical Activity. MVPA and sedentary behavior were measured with ActiGraph accelerometers (GT3X+ & GT3X-BT). Non-wear time was classified as 20 min of continuous zeroes in vertical axis counts. Participants were required to have at least four days, with at least 8 hours of valid wear time per day, to be included in analyses (compensated \$20 for adequate wear time). Time spent in MVPA was determined as the average MVPA according to four approaches (Crouter et al., 2012, Hanggi et al., 2013, Romanzini et al., 2014, Santos-Lazano et al., 2013), including three sets of cut-points ($>56 \text{ counts} \cdot \text{s}^{-1}$, $757\text{-}1111 \text{ counts} \cdot 15\text{-s}^{-1}$, and $2115\text{-}6548 \text{ counts} \cdot \text{min}^{-1}$) and a two-regression model. Time spent in sedentary behavior was determined as the average from three approaches (Crouter et al., 2012, Hanggi et al., 2013, Romanzini et al., 2014), including two sets of cut-points ($\leq 2 \text{ counts} \cdot \text{s}^{-1}$, $\leq 180 \text{ counts} \cdot 15\text{-s}^{-1}$) and a two-regression model. PA during the last seven days was also assessed with the PA Questionnaire – Adolescents (PAQ-A; Kowalski, Crocker, & Kowalski, 1997).

Psychosocial variables included: (a) *Autonomous Motivation for PA* assessed with the Behavior Regulation in Exercise Questionnaire-3 (BREQ-3). The subscales of intrinsic, integrated and identified were used to capture autonomous motivation (previous study results $\alpha=.61\text{-.}88$; $r=.23\text{-.}36$, $p=.01$; Dishman et al., 2018; Markland & Tobin, 2004; Wilson et al., 2006). The questionnaire is 24 questions long and rated by the respondent on a scale of 0 (not true) to 4 (very true) and is a multidimensional scale assessing the motivation continuum (Markland & Tobin, 2004; Wilson, Rodgers, Loitz & Scime, 2006). (b) *BPNS Scale* (Vlachopoulos, Ntoumanis, & Smith, 2010) was used to measure perceptions of competence, autonomy, and relatedness at the start of the club and end of the club. Examples include: (1) I feel exercise is an activity I do very well, (2) The way I exercise, is the way I want to, (3) My relationship with the people I exercise with is very friendly (Vlachopoulos, et al., 2010). This

11-item multidimensional scale was used to measure perceptions of competence, autonomy, and relatedness with a Likert rating of 1 (totally disagree) to 5 (totally agree). (c) *Autonomy-Supportive Environment* was assessed through the Perceived Autonomy Support Scale for Exercise Settings-PASSES (Hagger et al, 2007); 12-items scored on a seven-point Likert scale. It is one-dimensional and asks questions regarding whether the participant feels the TLC club instructor provides an autonomy-supportive environment (e.g., encourages me to engage in active sports and/or vigorous exercise in my free time; Hagger et al, 2007). (d) *Perceived Stress* was measured with the Perceived Stress Scale (ages 13-17; NIH, Kupst et al., 2015); 10-items on how students felt related to stress in the past month.

Intervention included three components: (1) two face-to-face PA events that reflected an autonomy-supportive environment (5-minute warm up; an enjoyable 60-minute PA session that included some choices regarding PA plus skill building with support from instructors; 10-minute cool-down stretching and discussion of MVPA); (2) daily motivational text messages (peer avatar); and (3) weekly PA goals and strategies via the club mascot (avatar). The control group maintained their usual after-school activities. The daily SDT-based messages were sent by the club participants to all participants; each participant sent messages 3-4 times and were given an option of two different messages that could be sent. The club instructors received a 4-hour intervention training prior to the face-to-face events and received a manual as a reference guide. The club instructors achieved 100% of the criteria for maintaining an autonomy-supportive environment, and no further training was needed. The intervention design and protocols were followed throughout the research. The club instructor provided a variety of PA choices for the students during the two face-to-face events (Lubans, et al., 2017). During each event's 10-minute cool down the club instructor discussed: setting goals, celebrating success, barriers to PA, and

participating in PA with peers. Attendance logs were completed at the two face-to-face events. The educational platform where messages were created and sent was monitored by the researcher.

Data analysis. IBM SPSS 28 was used to perform data analyses. Missing data were handled through the predictive mean matching method for imputation in SPSS (up to 20 imputations). The primary outcome was: min of MVPA per hour (ActiGraph); secondary outcomes included: min of sedentary behavior per hour (ActiGraph), perceived stress, BMI, %BF, and self-reported PA. Psychosocial variables included perceived autonomy-supportive environment, perceived BPNs, and autonomous motivation for PA. Descriptive data analyses were performed to describe the study variables and evaluate the assumptions for the statistical analysis. To evaluate the intervention preliminary efficacy a multivariate analysis of variance (MANOVA) was used. The post-intervention values were the dependent variables; the pre-intervention values were used as covariates, along with age, sex, and race. The intervention group membership was used as a predictor. An analysis of the residuals appeared normal with no outliers. Average partial eta-squared (η_p^2) was calculated as the effect size; .01=small effect, .06=medium effect, .14=large effect. Partial eta-squared is the percentage of remaining variances in the dependent variable explained by the independent variable after accounting for variances explained by covariates. To quantify partial eta squared, the average partial eta squared value was used for each outcome (averaged over the 20 imputed data sets).

Results. As shown in Figure 2.1, 37 HS students with completed consent/assent forms, were included in the study. Of the six participants assigned to the intervention group who did not complete the intervention, four provided no response (parent may have signed them up), one moved to a different district, and one had other commitments. Table 3.2 demonstrates the sample

characteristics of the 19 intervention students and 12 control students. Control and intervention groups were comparable regarding demographic variables; however, a significant between-group difference occurred for BMI and %BF (higher in control group).

Table 3.2: Demographics/Characteristics of Study Population; Means (Standard Deviations)

Variable	TLC (n=19)	Comparison Group (n=12)	Sig.
Sex: Male Female	n=6 (31.6%) n=13 (68.4%)	n=7 (58.3%) n=5 (41.7%)	.15
SES: <\$19,000 \$20-29,999 \$30-49,999 >\$50,000	n=0 n=0 n=3 (16.7%) n=15 (83.5%)	n=1 (9.1%) n=1 (9.1%) n=0 n=9 (81.8%)	.16
Race: Caucasian African American Other	n=16 (84.2%) n=2 (10.5%) n=1 (5.3%)	n=12 (100%) n=0 n=0	.35
Prior PA: No Yes	n=2 (10.5%) n=17 (89.5%)	n=3 (25%) n=9 (75%)	.29
Age	15.79 (1.23)	15.73 (.01)	.89
Grade	10.42 (1.17)	10.33 (1.07)	.83
MVPA min. per hr.	5.85 (1.80)	5.67 (1.57)	.80
Sed. Min. per hr.	44.80 (3.02)	47.00 (2.91)	.08
Perceived Stress	31.58 (4.54)	29.73 (6.92)	.38
BMI	21.31 (2.11)	27.82 (5.44)	<.01
% BF	20.56 (6.31)	28.36 (10.42)	.02
Self-Report PA	1.96 (.61)	1.86 (.66)	.69
Intrinsic	2.73 (.92)	2.75 (1.07)	.96
Integrated	2.21 (1.30)	1.93 (1.18)	.56
Identified	2.95 (.78)	2.77 (.62)	.53
PASSES	64.95 (16.02)	64.73 (10.36)	.97
Autonomy	3.79 (.52)	3.29 (.97)	.19
Competence	3.59 (.60)	3.32 (.85)	.31
Relatedness	3.67 (.74)	3.45 (1.16)	.54

*Note: top half of table chi-square analysis, bottom half of table t-tests.

TLC=Teen Leisure Time Physical Activity Club; SES=socioeconomic status; PA=physical activity; MVPA=moderate-to-vigorous physical activity; Sed=sedentary; BMI=body mass index; %BF=percent body fat; PASSES=Perceived Autonomy Support Scale in Exercise Settings

Feasibility. The enrollment rates at both schools were low: 25 of 950 intervention school students (2.63%) and 12 of 1015 control school students (1.18%). However, the retention rates

were acceptable: 19 (76%) at the intervention school, and 12 (100%) at the control school. Of the 19 intervention participants, 9 (47%) attended the first event, and 7 (36.8%) attended the second event. The number of daily motivational text messages sent and received was 100%.

Acceptability and satisfaction. The instructors agreed a lot (4) or a little (3) on all of the questions related to their evaluation of the intervention (questions were related to their skill to conduct the intervention, and satisfaction with the intervention). One instructor stated, “I LOVED the students sharing their excitement for this program. The feedback was so passionate from enjoying the fitness assessment from the trackers, changing their run or walk, and one girl now doing squats every time she brushes her teeth.” The satisfaction with the PA intervention was also evaluated through a participant post-intervention survey (n=7; 36.8%) received via a Qualtrics link after the intervention ended. Six of the seven participants (85.7%) agreed a little or a lot that the intervention in general was positive, and one participant disagree a little. The participants who rated the two club instructors agreed a little or a lot on most of the satisfaction questions, except for one participant who disagreed that the intervention helped to increase his/her MVPA or addressed his/her barriers to PA. All but one of the respondents would recommend the daily avatar messages and weekly PA goals and strategies to their friends. The daily avatar messages and weekly PA goals and strategies were also rated positively by six of the seven participants.

Preliminary efficacy. Table 3.3 shows each group’s pre- and post-intervention means and standard deviations, along with the pre-to post-change within each group.

Table 3.3: Intervention and Control Group Pre and Post Intervention Means, Standard Deviations, and Change Scores Over Time

Variable	TLC Group			Control Group		
	Pre	Post	Change	Pre	Post	Change
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
MVPA (min./hr.)	5.85 (1.80)	7.26 (2.35)	+1.41	5.67 (1.57)	7.25 (2.89)	+1.58
Sedentary Behavior (min./hr.)	44.80 (3.02)	42.81 (3.12)	-1.99	47.00 (2.91)	44.47 (5.03)	-2.53
Perceived Stress	31.58 (4.54)	31.6 (5.44)	+0.02	29.73 (6.92)	31.30 (4.45)	+1.57
BMI	21.31 (2.11)	21.61 (1.74)	+0.30	27.82 (5.44)	28.48 (5.93)	+0.66
% BF	20.56 (6.31)	21.22 (6.96)	+0.66	28.36 (10.42)	25.55 (8.63)	-2.81
Self-Report PA	1.96 (.61)	2.17 (.48)	+0.21	1.86 (.66)	2.66 (.83)	+0.80
Intrinsic Motivation	2.73 (.92)	2.95 (.95)	+0.22	2.75 (1.07)	3.05 (.80)	+0.30
Integrated Motivation	2.21 (1.30)	2.7 (1.02)	+0.22	1.93 (1.18)	2.22 (1.35)	+0.29
Identified Motivation	2.95 (.78)	3.28 (.69)	+0.33	2.77 (.62)	3.08 (.69)	+0.31
Autonomy-supportive Environment	64.95 (16.02)	69.53 (9.86)	+4.58	64.73 (10.36)	69.36 (7.00)	+4.63
Autonomy	3.79 (.52)	3.95 (.64)	+0.16	3.29 (.97)	3.85 (.87)	+0.56
Competence	3.59 (.60)	3.77 (.63)	+0.18	3.32 (.85)	3.80 (1.12)	+0.48
Relatedness	3.67 (.74)	3.73 (.76)	+0.06	3.45 (1.16)	3.93 (1.25)	+0.48

Note: Pre Intervention School n=15 Actigraph & n=19 anthropometric & surveys
Post Intervention School n=11 ActiGraph & n=15 anthropometric & surveys.
Pre Control School n=10 ActiGraph & n=12 anthropometric & surveys
Post Control School n=5 ActiGraph & n=10 anthropometric & surveys
TLC= Teen Leisure Time Physical Activity Club; SD=Standard Deviation;
MVPA=Moderate-to-Vigorous Physical Activity; BMI=Body Mass Index; %BF=Percent Body Fat; PA=Physical Activity

As noted in Table 3.4, after controlling for baseline age, sex, race and outcome variables, no statistically significant differences were noted between intervention and control groups for any outcomes. However, several outcomes changed in the expected direction at the intervention group when comparing the control group, as indicated by the regression coefficients: MVPA ($B=2.31$), sedentary behavior ($B=5.33$), %BF ($B=1.47$), perceived stress ($B=3.59$), autonomy-supportive environment ($B=8.89$), autonomy ($B=1.13$), integrated motivation ($B=.94$), relatedness ($B=.61$), identified motivation ($B=.20$). Based on the effect sizes demonstrated in Table 3.4, the intervention had a large effect in decreasing sedentary behavior ($\eta_p^2=.22$), and improving integrated motivation ($\eta_p^2=.20$), and autonomy ($\eta_p^2=.38$). Moreover, the effects in reducing %BF ($\eta_p^2=.12$) and increasing MVPA ($\eta_p^2=.13$), relatedness ($\eta_p^2=.10$), autonomy-supportive environment ($\eta_p^2=.12$), and self-reported PA ($\eta_p^2=.13$) were moderate.

Table 3.4: Comparison of Outcome Variable Changes Over Time between Intervention and Control Group

Intervention-Control Group		B (change predicted from the multivariate regression)	Std. Error	t statistic	Sig. p value	95% CI of B			95% CI of η^2_p	
Outcome (post-treatment)	Expected Change in Intervention Group					Lower Bound	Upper Bound	Average Partial Eta Squared η^2_p	Lower Bound	Upper Bound
MVPA	↑	2.31 (↑)	4.29	0.54	0.59	-6.17	10.78	.13	.000	.597
Sedentary Behavior	↓	-5.33 (↓)	6.33	-0.84	0.40	-17.83	7.17	.22	.001	.681
Perceived Stress	↓	3.59 (↓)	6.51	0.55	0.58	-9.22	16.39	.09	.001	.249
BMI	↓	0.01 (↑)	3.24	0.004	1.00	-6.37	6.39	.05	.000	.214
%BF	↓	-1.47 (↓)	5.18	-0.28	0.78	-11.74	8.80	.12	.001	.362
Self-Report PA	↑	-0.18 (↓)	0.65	-0.27	0.79	-1.48	1.12	.13	.001	.522
Intrinsic Motivation	↑	-0.35 (↓)	0.96	-0.36	0.72	-2.24	1.54	.04	.000	.192
Integrated Motivation	↑	0.94 (↑)	1.08	0.87	0.39	-1.19	3.06	.20	.007	.548
Identified Motivation	↑	0.20 (↑)	0.59	0.34	0.73	-0.96	1.36	.07	.001	.387
Autonomy-supportive Environment	↑	8.89 (↑)	14.54	0.61	0.54	-19.69	37.46	.12	.000	.307
Autonomy	↑	1.13 (↑)	0.82	1.39	0.17	-0.48	2.75	.38	.002	.783
Competence	↑	-0.16 (↓)	0.63	-0.26	0.80	-1.41	1.08	.05	.000	.223
Relatedness	↑	0.61 (↑)	1.10	0.55	0.58	-1.56	2.77	.10	.000	.306

Note: *Partial Eta Squared $\eta^2_p = SS_{\text{effect}} / (SS_{\text{effect}} + SS_{\text{error}})$: (.01=small effect, .06=medium effect, .14=large effect). MVPA=Moderate-to-

Vigorous Physical Activity; BMI=Body Mass Index; %BF=Percent Body Fat; PA=Physical Activity; SD=Standard Deviation

Discussion. In this pilot study, the feasibility, acceptability, and preliminary effects of a PA intervention were evaluated to inform the conduct of future large-scale trials. Recruitment and enrollment will need to be improved in future studies, but the retention rate for participants in the program was acceptable at 83%. A systematic review of health behavior change interventions in young adults (ages 17-35) showed that the included studies had low recruitment rates, ranging from 7.5%-48% (Whatnall et al., 2021), consistent with the low recruitment rate in this intervention with adolescence. However, fewer than half of the studies (46%) in the review (n=107 RCTs) did not report recruitment results (Whatnall et al., 2021). The systematic review (Whatnall et al., 2021) reported adequate retention rates of 65%; and the current intervention achieved 83% demonstrating higher than average retention. For the TLC study, retention rates may have been negatively impacted by the pandemic. The pandemic created unique challenges for conducting school-based research due to the sudden onset of stay-at-home orders, social distancing, and mandated quarantines. Students and families may have felt hesitant to join in any unessential activities that may have put them at a higher risk for exposure. On average, attendance at the two face-to-face club sessions was less than 50%. Reasons for not attending included: illness, or other priorities on the same day. Competing priorities (academics, employment, and other social activities) have been an obstacle that prevents participation in PA among HS students (Eime et al., 2010). In a meta-analysis by Beets et al. (2009) that included studies with after-school PA interventions, attendance rates were positively associated with program outcomes, suggesting that greater exposure to the intervention is related to improved outcomes. Compared to the average after-school attendance rate of 56% in a large randomized controlled trial with young adolescents who may not have as many competing priorities, the attendance rate in the current study was comparable (Wilson, Van Horn et al., 2011). Therefore,

increasing attendance in the intervention will be imperative for improved future outcomes. On a positive note, qualitative data from the instructors' and participants' post-intervention surveys supported the acceptability.

Research demonstrates that PE teachers and instructors who can maintain an autonomy-supportive learning environment have better student learning outcomes in the PE environment (Vasconcellos et al., 2019). The autonomy-supportive PA environment for the TLC intervention focusing on enhancing several perceptions related to PA: 1) *Autonomy*: Instructors provided options to show the HS students how they could maintain PA during the two face-to-face events; students were told they could participate in any form of PA to be active outside of club days; a quarter of the SDT-based daily messages were related to choice; and participants were given a choice related to which message they could send; 2) *Competence*: Instructors provided PA skill-building lessons at the two face-to-face events; a quarter of the SDT based daily messages were based on building confidence in the students' PA skills; and the weekly PA goals and strategies provided information to help build PA competence; 3) *Relatedness*: During the two face-to-face events participants met other peers who were interested in PA; the daily SDT were coming from a peer participating in the program; and a quarter of the SDT-based daily messages focused on encouraging relatedness with other peers who participate in PA. The effect size for autonomy was large ($\eta_p^2 = .38$), making this an important variable to emphasize in future studies among adolescents. Adolescence is a stage of development when their autonomy may have a greater impact on outcomes due to adolescents seeking to make choices on their own (Healthy People, 2020; Jarvis, 2019). The study results, are similar to Schneider and Kwan's (2013) study that showed a significant correlation of .19 to .29 ($p < .003$) between perceived PA autonomy and autonomous motivation for PA. Unfortunately, although an autonomy-supportive environment

was maintained effectively by the trained instructors at the two face-to-face events, the intervention was acceptable to the HS students, and the SDT-based daily messages and weekly PA goals and strategies supported an autonomy-supportive PA environment, MVPA did not improve at a statistically significant level however, it did improve more in the intervention than control group. In addition, the effect size for sedentary behavior was large ($\eta_p^2=.22$), incorporating information in the intervention related to why sedentary behavior can negatively impact participant's health may help improve physical activity behavior (Barnett et al., 2018).

The finding that no significant change occurred for MVPA, sedentary behavior, perceived stress, BMI, %BF, and self-reported MVPA at post-intervention was not completely surprising because our intervention did not significantly increase the psychosocial variables of BPNs, perceptions of an autonomy-supportive environment, or autonomous motivation for PA. However, many of the outcomes were changed in the expected direction, and obtaining significance with a small sample size can be challenging. Additional strategies or a greater dose may be needed in an autonomy-supportive PA environment to result in significant changes in the BPNs or autonomous motivation for PA, and then improvement in the intended behavioral outcomes. Additionally, seeing long-term changes in behaviors, such as PA, may require a longer intervention period (Kennedy et al., 2021). A systematic review by Hynynen et al. (2016) of 10 randomized or cluster randomized control trials with school-based interventions to increase PA and decrease sedentary behavior found that the effects were small, similar to the lack of any significant effect in this study. Hynynen and colleagues concluded that more studies were needed to evaluate long-term effectiveness of PA interventions for HS students. The between-group difference in BMI and %BF (higher in control group) may be contributing to the insignificant effect as well. Past research has found that HS students who are overweight or obese tend to

participate in less PA than HS students in healthy weight categories (Skogen & Hoydal, 2021). However, these participants may have had greater motivation to change behavior resulting in a greater change in the outcome compared to students in the healthy weight category at baseline. The Trans Theoretical Model posits that individuals move through six stages of change, the stage that the participant is in at baseline may have impacted their level of participation (Prochaska, Johnson, & Lee, 1998). However, the motivation scores of the participants at baseline did not have statistically significant differences between intervention and control groups. In future studies, groups need to be comparable in their BMI and %BF, so these confounding variables do not impact the significance of the results.

Although ActiGraphs are the gold standard for monitoring PA, this approach has some challenges. When the ActiGraphs were distributed at the data collection events, the instructions to the participants were that the ActiGraph was used to measure their PA but they were not being asked to be more active. However, many of the participants considered wearing the ActiGraph as a component of the study and therefore purposefully increased their PA level to have an adequate PA level. On the contrary, participants who did not improve their PA may have chosen not to wear the ActiGraph the second time, so that their low level of PA wouldn't be recorded. Improving wear compliance, by explaining that the ActiGraph is not an intervention component will be needed to adequately compare pre and post data.

Limitations. The pilot study had strengths and limitations. The study addressed the notable gap in research on PA interventions for rural HS students. The data obtained can contribute to modifications of the intervention in future large-scale studies. However, the sample size was small, so any practical implications for future work should be considered with caution due to the small sample size of the study. Also, because students volunteered to participate, the

generalizability to groups not interested in participating in a PA study may be limited. Future studies, should include randomization of larger samples to both intervention and control groups. Another possible limitation is that the HS students' responses may be biased because they did not want to report negative aspects of the study. Additionally, although messages were received by participants, whether the messages were read or specifically resulted in behavior change was not monitored. Despite these limitations, this study represents an important step towards elucidating issues that may arise when conducting PA studies.

Conclusion. Study findings suggest that some rural HS students are interested in face-to-face events that offer PA in an autonomy-supportive environment with adult leaders and peers who are also interested in PA. However, future researchers may want to consider using multiple or novel ways to offer PA in the schools as well as strategies to attain an adequate sample.

REFERENCES

- Barnett, T. A., Kelly, A. S., Young, D. R., Perry, C. K., Pratt, C. A., Edwards, N. M., . . . Vos, M. B. (2018). Sedentary behaviors in today's youth: Approaches to the prevention and management of childhood obesity: A scientific statement from the American Heart Association. *Circulation*, 138(11), e142-e159. doi:10.1161/CIR.0000000000000591
- Beets MW, Beighle A, Erwin HE, Huberty JL. (2009). After-school program impact on physical activity and fitness: A meta-analysis. *American Journal of Preventive Medicine*;36(6):527-537. doi:10.1016/j.amepre.2009.01.033
- Centers for Disease Control and Prevention (n.d). Adolescent health (2020). Retrieved from: <https://www.healthypeople.gov/2020/topics-objectives/topic/Adolescent-Health>
- Centers for Disease Control and Prevention. (2019) Youth Risk Behavior Survey Questionnaire. Available at: https://www.cdc.gov/healthyyouth/data/yrbs/factsheets/2019_obesity_trend_yrbs.htm Accessed on July 7, 2022
- Crouter, S.E., Horton, M., & Bassett Jr., D.R. (2012). Use of a 2-regression model for estimating energy expenditure in children. *Medicine and Science in Sports and Exercise*, 44(6).
- Dishman, R., McIver, K., Dowda, M., & Pate, R. (2018). Declining physical activity and motivation from middle school to high school. *Medical Science Sports Exercise*, 50(6):1206-1215 doi: 10.1249/MSS.0000000000001542
- Dudley, D., Mackenzie, E., Van Bergen, P., Cairney, J., & Barnett, L. (2022). What Drives Quality Physical Education? A Systematic Review and Meta-Analysis of Learning and Development Effects From Physical Education-Based Interventions. *Frontiers in psychology*, 13, 799330. <https://doi.org/10.3389/fpsyg.2022.799330>
- Eime R., Payne, W., Casey, M., & Harvey, J. (2010). Transition in participation in sport and unstructured physical activity for rural living adolescent girls. *Health Education Research*, 25(2), 282-93.
- Euler R., Jimenez E., Sanders S., Kuhlemeier A., Van Horn M., Cohen D., et al. (2019). Rural–urban differences in baseline dietary intake and physical activity levels of adolescents. *Preventing Chronic Disease*, 16:180200. doi.org/10.5888/pcd16.180200external icon.
- Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. *The Lancet. Child & adolescent health*, 4(1), 23–35. <https://doi.org/10.1016>

- Ha, A., Lonsdale, C., Ng, J. , & Lubans, D. (2017). A school-based rope skipping program for adolescents: Results of a randomized trial. *Preventive Medicine*, 101, 188-194. doi:10.1016/j.ypmed.2017.06.001
- Hagger, M., Chatzisarantis, N., Hein, V., Pihu, M., Soós, I., & Karsai, I. (2007). The perceived autonomy support scale for exercise settings (PASSES): Development, validity, and cross-cultural invariance in young people. *Psychology of Sport and Exercise*, 8(5), 632-653.
- Hanggi, J.M., Phillips, L.R.S., & Rowlands, A.V (2013). Validation of the GT3X ActiGraph in children and comparison with the GT1M ActiGraph. *Journal of Science and Medicine in Sport*, 16(1).
- Healthy People (2020). Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, retrieved from: <https://www.healthypeople.gov/2020/topics-objectives/topic/Adolescent-Health>
- Hibbing P. (2018). Two regression: Process data from wearable research devices using two-regression algorithms.
- Hu, K., & Staiano, A.E. (2022). Trends in obesity prevalence among children and adolescents aged 2 to 19 years in the US from 2011 to 2020. *JAMA Pediatrics*. Published online July 25, 2022. doi:10.1001/jamapediatrics.2022.2052
- Hynynen, S., Van Stralen, M., Sniehotta, F., Araújo-Soares, V., Hardeman, W., Chinapaw, M. M., . . . Hankonen, N. (2016). A systematic review of school-based interventions targeting physical activity and sedentary behaviour among older adolescents. *International Review of Sport and Exercise Psychology*, 9(1), 22-44. doi:10.1080/1750984X.2015.1081706
- Kelley, G. A., Kelley, K. S., & Pate, R. R. (2019). Exercise and adiposity in overweight and obese children and adolescents: a systematic review with network meta-analysis of randomised trials. *BMJ open*, 9(11), e031220. <https://doi.org/10.1136/bmjopen-2019-031220>
- Kennedy, S. G., Sanders, T., Estabrooks, P. A., Smith, J. J., Lonsdale, C., Foster, C., & Lubans, D. R. (2021). Implementation at-scale of school-based physical activity interventions: A systematic review utilizing the RE-AIM framework. *Obesity reviews : an official journal of the International Association for the Study of Obesity*, 22(7), e13184. <https://doi.org/10.1111/obr.13184>
- Kowalski, K. C., Crocker, P. R. E., & Kowalski, N. P. (1997). Convergent validity of the Physical Activity Questionnaire for Adolescents. *Pediatric Exercise Science*, 9, 342- 352.
- Kupst, M. J., Butt, Z., Stoney, C. M., Griffith, J. W., Salsman, J. M., Folkman, S., & Cella, D. (2015). Assessment of stress and self-efficacy for the NIH Toolbox for Neurological and

- Behavioral Function. *Anxiety, stress, and coping*, 28(5), 531–544.
<https://doi.org/10.1080/10615806.2014.994204>
- Lubans, D., Lonsdale, C., Cohen, K., Eather, N., Beauchamp, M., Morgan, P., . . . Smith, J. (2017). Framework for the design and delivery of organized physical activity sessions for children and adolescents: rationale and description of the ‘SAAFE’ teaching . *International Journal of Behavioral Nutrition and Physical Activity*, 14(1), 24.
doi:10.1186/s12966-017-0479-x
- Markland D, & Tobin V (2004). A modification of the behavioral regulation in exercise questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*; 26; 191-196.
- Ntoumanis, N., Ng, J., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Lonsdale, C., & Williams, G. C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: effects on motivation, health behavior, physical, and psychological health. *Health psychology review*, 15(2), 214–244. <https://doi.org/10.1080/17437199.2020.1718529>
- Nuttall F. Q. (2015). Body mass index: Obesity, BMI, and health: A critical review. *Nutrition Today*, 50(3), 117–128. doi:10.1097/NT.0000000000000092
- Owen, K., et al. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive Medicine* 67: 270-279.
- Palmer, K., Robbins, L.B., Ling, J., Kao, T., Voskuil, V.R., & Smith, A.L, (2020). Adolescent autonomous motivation for physical activity: A concept analysis, *Journal of Pediatric Nursing*, ISSN 0882-5963, doi.org/10.1016/j.pedn.2020.04.020.
- Pate, Flynn, & Dowda (2016). Policies for promotion of physical activity and prevention of obesity in adolescence, *Journal of Exercise Science & Fitness*,14,(2),
doi.org/10.1016/j.jesf.2016.07.003.
- Pfledderer, C. D., Burns, R. D., Byun, W., Carson, R. L., Welk, G. J., & Brusseau, T. A. (2021). School-based physical activity interventions in rural and urban/suburban communities: A systematic review and meta-analysis. *Obesity reviews : an official journal of the International Association for the Study of Obesity*, 22(9), e13265.
<https://doi.org/10.1111/obr.13265>
- Piercy, K., Troiano, R., & Ballard, R., et al. (2018). The Physical Activity Guidelines for Americans. *JAMA*.2018;320(19):2020–2028. doi:10.1001/jama.2018.14854
- President’s Council on Fitness, Sports and Nutrition. Facts and Statistics (n.d.). 2017 Retrieved from: <https://www.hhs.gov/fitness/resource-center/facts-and-statistics/index.html>

- Prochaska, J. O., Johnson, S., & Lee, P. (1998). The transtheoretical model of behavior change. In S. A. Shumaker, E. B. Schron, J. K. Ockene, & W. L. McBee (Eds.), *The handbook of health behavior change* (pp. 59–84). Springer Publishing Company.
- Romanzini, M., Petroski, E.L., Ohara, D., Dourado, A.C., & Reichert, F.F (2014). Calibration of ActiGraph GT3X, Actical and RT3 accelerometers in adolescents. *European Journal of Sport Science*, 14(1).
- Ryan, R., & Deci, E. (2017). Self-Determination theory. Basic psychological needs in motivation, development and wellness. Guilford Press, New York, London.
- Saez, L., et al. (2018). Using facilitator–receiver peer dyads matched according to socioeconomic status to promote behaviour change in overweight adolescents: a feasibility study. *BMJ Open* 8(6): e019731.
- Santos-Lozano, A., Santin-Medeiros, F., Cardon, G., Torres-Luque, G., Bailon, R., Bergmeir, C., et al. (2013). Actigraph GT3X: Validation and determination of physical activity.
- Schneider, M. & Kwan, B. (2013). Psychological need satisfaction, intrinsic motivation and affective response to exercise in adolescents. *Psychology of Sport Exercise*, 14(5), 776-785.
- Skogen, I. B., & Høydal, K. L. (2021). Adolescents who are overweight or obese - the relevance of a social network to engaging in physical activity: a qualitative study. *BMC public health*, 21(1), 701. <https://doi.org/10.1186/s12889-021-10727-7>
- Smith, J. D., Fu, E., & Kobayashi, M. A. (2020). Prevention and Management of Childhood Obesity and Its Psychological and Health Comorbidities. *Annual review of clinical psychology*, 16, 351–378. <https://doi.org/10.1146/annurev-clinpsy-100219-060201>
- U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD), Retrieved from: https://nces.ed.gov/fastfacts/display.asp?id=372#PK12_enrollment
- Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2020). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology*, 112(7), 1444–1469. <https://doi.org/10.1037/edu0000420>
- Vlachopoulos S., Nikos Ntoumanis, N., & Smith, A. (2010). The basic psychological needs in exercise scale: Translation and evidence for cross-cultural validity. Retrieved from: [http://selfdeterminationtheory.org/SDT/documents/Vlachopoulos_et_al_2010\[1\].pdf](http://selfdeterminationtheory.org/SDT/documents/Vlachopoulos_et_al_2010[1].pdf)
- Whatnall, M., Hutchesson, M., Sharkey, T., Haslam, R., Bezzina, A., Collins, C., . . . Ashton, L. (2021). Recruiting and retaining young adults: What can we learn from behavioural interventions targeting nutrition, physical activity and/or obesity? A systematic review of

the literature. *Public Health Nutrition*, 24(17), 5686-5703.
doi:10.1017/S1368980021001129

Wilson, D. K., Lawman, H. G., Segal, M., & Chappell, S. (2011). Neighborhood and parental supports for physical activity in minority adolescents. *American Journal of Preventive Medicine*, 41, 399–406. doi:10.1016/j.amepre.2011.06.037

Wilson, P., Rodgers, W., Loitz, C., & Scime, G. (2006). “It’s who I am...really!” The importance of integrated regulation in exercise contexts. *Journal of Biobehavioral Research*, 11, 79-104.

CHAPTER FOUR: PERSPECTIVES OF HIGH SCHOOL STUDENTS INVOLVED IN A MULTI-COMPONENT, AFTER-SCHOOL PHYSICAL ACTIVITY INTERVENTION

Abstract. After-school physical activity (PA) interventions can assist high school students to meet moderate-to-vigorous PA (MVPA) recommendations calling for at least 60 minutes per day; however, little is known about the perspectives of high school (HS) students, especially those living in rural areas, for strengthening these interventions.

Purpose: The purpose of this qualitative study was to explore rural HS students' experiences with and perceptions of a multi-component, after-school PA intervention.

Design and Methods: One-on-one semi-structured interviews were conducted via Zoom with 10 students who participated in the PA intervention offered at one HS in the Midwestern United States. Interviews were recorded and transcribed verbatim and NVivo Software was used. Two independent reviewers coded the data. Thematic analysis was conducted on the interviews by two investigators until consensus was reached.

Results: Two categories with nine themes were identified and described in detail. Briefly, rural HS students perceived that their multiple responsibilities and lack of essential support prevented them from achieving their PA goals. The findings underscored the importance of incorporating the perspectives of rural HS students when developing and implementing PA interventions for this specific group.

Conclusions: The qualitative approach was helpful for understanding perspectives of adolescents participating in a PA intervention and identifying factors contributing to or hindering PA participation. Findings can be used to inform the development of future PA interventions for rural HS students to help them overcome perceived barriers to PA.

Keywords: exercise, obesity, high school, qualitative research, intervention

Introduction

Current rates of adolescent physical activity (PA) are disturbingly low globally even though a robust body of evidence supports that numerous benefits to physical and mental health are achieved from attaining adequate PA (Youth Risk and Behavior Survey [YRBS], 2019; World Health Organization [WHO], 2020). Based on findings from YRBS (2019), only 23% of high school (HS) students in the US are meeting established guidelines calling for 60 minutes of MVPA daily. Physical inactivity contributes to the alarmingly high rate of obesity noted among HS students (15.5%), which increases their risk of developing noncommunicable chronic diseases (e.g., type 2 diabetes, cardiovascular disease, and depression; YRBS, 2019; WHO, 2020). As a result, this young population has been identified as an important group to target for improving health outcomes in the U.S. (Yousefian & Hartley, 2015), and the development of effective interventions to increase adolescents' PA has become a major public health priority. Given that 70% of adolescent stop participating in youth sports by age 13, and few are required to take physical education throughout their schooling, alternative and acceptable PA programs are urgently needed for HS students in rural areas to support their continued PA (National Alliance of Youth Sports, 2018).

After-school settings are identified as being ideal for implementing PA interventions because large numbers of students are exposed to structured programs after school and are familiar with this format. Previous after-school PA interventions have had a moderate-effect on PA (SMD=.44; Beets et al., 2009; Heath et al., 2012). Only one after-school PA intervention was found that included HS students (grades 7-12). The 8-week extracurricular sport program (Luban & Morgan, 2008), which was based on Social Cognitive Theory had a significant effect on increasing pedometer steps for students classified at baseline as low-active, as opposed to active;

however, the clinical significance of the intervention was limited because the low-active students did not meet the steps per day recommendation after the intervention (girls > 11,000 steps/day, and boys > 13,000 steps/day; Luban & Morgan, 2008). Moreover, the intervention did not incorporate technology, which is recommended to meet the needs of HS students (Loescheer et al., 2018). Finally, the intervention was not conducted in a rural setting, where HS students are in particular need of PA support. Despite evidence of efficacy of PA interventions in the after-school setting (Beets et al., 2009; Heath et al., 2012), implementation of PA interventions is challenging given the variability of factors influencing success (e.g., resources, infrastructure, support from school and community agencies).

Another approach, that is currently being promoted, but has not yet been used in any after-school interventions for HS students, involves the development of an autonomy-supportive PA environment to help increase the students' autonomous motivation for PA (Aelterman et al., 2016; De Meester et al., 2017; Kerner & Goodyear, 2017). Self-determination Theory (SDT) has been applied extensively in research aimed at understanding motivation for PA among adolescents (Teixeira et al., 2013) and has been used to guide PA interventions (Fortier et al., 2012). Interventions addressing all components of the SDT, including the three Basic Psychological Needs (BPNs) of competence, autonomy, and relatedness, have potential for improving intended outcomes (Teixeira et al., 2013). An autonomy-supportive environment is consistently identified as being important for improving the BPNs and motivating adolescents to increase their PA (Standage, Duda, & Ntoumanis, 2005). This theory was used to guide the development of a 10-week after-school PA intervention for rural, HS students that adhered to recommendations for including technology and creating an autonomy-supportive environment. Specifically, the intervention included two after-school face-to-face group events, daily SDT-

based motivational avatar/text messages sent to each student's phone by a peer, and weekly PA goals and strategies sent to each student's phone by a club mascot avatar chosen by the HS students at the beginning of the intervention. The PA intervention was implemented and evaluated with interested students in one rural HS during the 2021-2022 academic year.

According to Ryan and Deci (2017) autonomy-supportive PA environments are those that can: (1) provide HS students with options related to the PA so that they can choose what they want to engage in (autonomy), (2) help HS students develop skills so that they can feel successful when engaging in PA (competence), and (3) assist HS students in building quality relationships with others who can support their PA (relatedness). The intervention evaluated, provided these three components in a variety of ways.

Few studies have qualitatively examined HS students' perspectives after participating in a PA intervention. To increase the quality of PA interventions, an evaluation by participants that includes their satisfaction with and recommendations for improving interventions is essential (Fynn, et al., 2020). Participant involvement for development and implementation of PA intervention is important, yet few studies were found that utilized HS students in the process of evaluating PA interventions. Understanding the perspectives of HS students may provide important insight into how PA interventions can increase MVPA and reduce sedentary behavior in this age group. The aim of this study was to explore HS students' perspectives on the design and delivery of a multi-component PA intervention in rural HS students to inform future implementation.

Qualitative thematic analysis research (Braun & Clark, 2006; Glesne, 2011; Thompson et al., 2022) was used to explore rural HS students' experiences with and perceptions of a multi-component, after-school PA intervention. Specifically, adolescents were asked about their

satisfaction with the PA intervention and whether the PA environment was autonomy-supportive and motivating (promoted autonomy, competence, and peer relatedness) during the PA intervention. For the original study that tested the effect of the intervention on adolescents' MVPA and other outcomes, nineteen HS students received the TLC intervention. Two high schools located in a rural county were selected. School and administrators were asked whether they were interested in having their school participate. For this convenience sample, the HS with higher participation was selected to receive the TLC intervention, and the other school served as the control condition receiving usual after-school activities.

The two main research questions guiding this study were:

- 1) How do rural, HS students evaluate their experience in an intervention that includes an autonomy-supportive environment to increase PA? and,
- 2) What approaches do HS students feel optimally promote autonomy and competence and leverage peer relatedness to increase PA?

Methods

Study Design

Data for this qualitative study were obtained from semi-structured interviews conducted as a part of a larger study that included an after-school intervention titled *Teen Leisure Time PA Club (TLC)*. The TLC intervention was aimed at increasing MVPA among rural, HS students in a Midwestern U.S. HS. The university institutional review board and the school district approved this study. The study included semi-structured interviews to investigate the experiences and perceptions of adolescents who participated in the PA intervention.

Participants and Setting

To be selected to participate in the interview, a participant had to meet the following two criteria: (1) participated in at least one of the two face-to-face events, and (2) participated in sending at least one of the SDT-based motivational avatar/text messages. Of the 10 participants receiving the TLC intervention who had met these criteria, all ten were willing to participate in the interviews.

Data Collection Procedure

Consent/assent for the participation in the interviews was received during the parent study. Copies of the consent and assent were stored electronically on a secure server. HS students who received the intervention were invited to participate in the interviews via text message, telephone, and/or email sent by the first author. One follow-up message was sent to those who did not respond to the initial request to participate. The original consent and assent form included an area where the parent and HS student could indicate interest in the interview and agree to have the interview with the student participant recorded. Response rates were tracked by the research team and project staff who were trained by the first author to protect the confidentiality of any collected data. Then, project staff contacted each participant to arrange a convenient time for the interviews to take place via Zoom ®/telephone between March 2022 and April 2022. Before the first interview session started, three pilot interviews were conducted to test the interview guide. No changes were found to be necessary. After completing the interview, participants were thanked for their participation and received \$20 cash for participating in the interview.

A semi-structured interview was conducted with participants (Table 4.1) prompting participants to describe their perceptions of the TLC intervention. In developing the interview

guide, the first author considered the types of information that would be relevant to evaluate the intervention implemented in the original study. Questions were worded to discover the perceptions of participants related to (1) creating an autonomy-supportive PA environment, (2) promoting autonomy, competence, and peer relatedness during the PA intervention and (3) determining satisfaction with the PA intervention. All interviews were conducted by the first author. With parent and participant permission, Zoom ® audio technology recorded the interviews. The interviews lasted approximately 30-45 minutes, and each one was transcribed verbatim via Landmark Associates, a professional transcription company. The first author took field notes during each interview utilizing a standard template that was part of the research protocol. After each interview, additional hand-written field notes were made about the surroundings, mood of the participants, and any interruptions, to ensure comprehensive interpretation of the data.

Following each participant interview, the audio data were transferred and stored in electronic format to a password-protected secure server within the first author's institution. Each recording was stripped of personal identifiers. Integrated with appropriate protection, the server conducted backups each night and was supported by institutional technology support services.

Table 4.1: Semi-structured Interview Guide

<i>High School Students' Perceptions with a PA intervention:</i> 1) To start with, what can you tell me about the overall experience of the whole program? 2) The two face-to-face events that we did, what did you like about those events? 3) What did you dislike about the face-to-face events? What about the amount of time for the two face-to-face events? Was this long enough? Too long? 4) What are some of the barriers that prevented you from participating in the face-to-face events? 5) What are some of the barriers that prevented you from participating in the daily motivational messages (receiving or sending)? 6) What about the club mascot, was the mascot appropriate? Did you enjoy receiving the goals and strategies from the mascot? Did they support your physical activity? 7) What are some of the barriers that prevented you from receiving the weekly goals and strategies if you did not? 8) What about the duration of the whole club? Just right, too long, too short? 9) What do you think we could do to make the club better? 10) How does the club, in general, influence your thoughts and behaviors related to physical activity? <i>Autonomy-supportive PA environment</i> 11) What kind of support would you have needed to attend the face-to-face events if you did not? Or any additional support at the event that would have been helpful? 12) What kind of support would you have needed to send or receive the daily avatar messages if you did not? 13) What kind of support would you have needed to receive the weekly goals and strategies? 14) How do those in the club support you? 15) What kind of environment do you feel like the club had? <i>Peer relatedness during the PA intervention:</i> 16) What about the daily motivation messages from peers; did you enjoy receiving them? Did you enjoy sending them? 17) Did the avatars support the messages? How? 18) Tell me about the peers in this group you feel connected to. 19) Tell me about some of the positive situations with others during the club that you enjoyed. 20) Tell me how you plan to continue to exercise with these individuals/peers? 21) Tell me about any negative situations you had with others during the club. 22) Any additional thoughts or comments you would like to share?

Data analysis

Descriptive statistics were used to describe the adolescent's demographic characteristics that were obtained during the parent study. Qualitative data analysis was supported by using the NVivo 12 software program to organize through themes and code created by the author.

Interviews were transcribed verbatim from the recording, and uploaded to NVivo 12 software. Thematic analysis was conducted to understand how participants perceived the autonomy-supportive PA environment, how they perceived peer relatedness in the PA intervention, and if they were satisfied with the PA intervention (Braun & Clark, 2006). The first reviewer developed initial codes after reviewing the interviews, and the second reviewer independently coded the data set using the initial codes identified by the first author. The first and second author then analyzed the data separately. Codes arose through a deductive approach (theory based), but also through an inductive approach (codes arose purely from the data, to ensure important aspects of the data were not missed). The authors met after reviewing all of the data to discuss discrepancies and refine the coded data, themes, and subthemes together to reach final consensus (Braun & Clark, 2006; Glesne, 2011; Thompson et al., 2022). Finally, thematic analysis was used to analyze the study data (Braun & Clark, 2006; Glesne, 2011; Thompson et al., 2022). Throughout the coding process both reviewers selected compelling quotes to support and illustrate each theme (Braun & Clark, 2006; Glesne, 2011; Thompson et al., 2022).

Results

The demographic information for the 10 HS students who participated in the interview is presented in Table 4.2 and is a representative sample of the 19 students who participated in the PA intervention. Seven were female, and three were male. The HS students ranged in age from 14-17 years old (mean = 15). Two were in the 9th grade, one was in the 10th grade, six were in the 11th grade, and one was in the 12th grade. All 10 students self-reported in an initial screening that they were active in some form of PA (school or club-based) prior to the intervention beginning.

Table 4.2: Participant Characteristics

	Sex	Age	Grade	Ethnicity	BMI
Participant A	Female	16	11 th	Caucasian	20.5
Participant B	Female	17	11 th	Caucasian	21.6
Participant C	Female	16	11 th	Caucasian	22.6
Participant D	Female	15	9 th	Caucasian	17.4
Participant E	Male	14	9 th	African American	19.1
Participant F	Male	17	11 th	Caucasian	18.7
Participant G	Female	17	11 th	Caucasian	20.3
Participant H	Female	16	11 th	Caucasian	20.1
Participant I	Male	17	12 th	Caucasian	22
Participant J	Female	15	10 th	Caucasian	20.5

Categories

HS students' perspectives from the qualitative data were organized into the themes derived within each of the following two categories of interest based on the research questions: (1) autonomy-supportive PA environment, and (2) satisfaction with the PA environment (see Table 2.3).

Autonomy-supportive PA environment. Autonomy-supportive PA environments are climates that are associated with greater autonomous motivation for PA because they give participants' choices (autonomy), help them develop PA skills that improve confidence (competence), and include others that are experiencing the same environment (relatedness; Ryan & Deci, 2017). During the interviews the HS students identified additional helpful factors that they associated with an autonomy-supportive environment for PA.

Theme 1. Autonomy provides adolescents with some choice during their activities (Ryan & Deci, 2017). In all of the 10 interviews, the HS students specifically reported that the intervention supported their autonomy. Statements indicating that the intervention allowed them to choose the particular PA they wanted to do were made by participants a total of 13 times. Two examples of statements from participants that showed the intervention promoted autonomy were:

“I liked how they had a bunch of different exercises you could try out and see which ones you liked,” and “I liked how there were a bunch of different options, so you could kind of pick and choose what you wanted to do and what you liked to do”.

Theme 2. Competence involves acquiring skills that give HS students confidence in their ability to be successful when engaging in PA (Ryan & Deci, 2017). In all 10 interviews, participants specifically indicated that the intervention increased their level of competence for engaging in PA. Comments about learning important skills for engaging in PA as a result of participating in the intervention were made a total of 10 times by participants. Two examples that reflected how the intervention promoted increased competence included:

“..you had the things that you were familiar with, so you were confident—“, and “I feel more confident in myself that I can do the physical activity because I’ve been doing it so much more often than I used to.”

Theme 3. Relatedness is an adolescent’s perception of feeling socially connected with significant people (Alali et al., 2020) and involves building quality relationships with those who can support PA. In all 10 interviews, HS students stated that the intervention helped them connect to others who could assist them with increasing their PA. Statements related to this code were made by participants a total of 48 times across all 10 interviews. Peer relatedness during the PA intervention was explored in greater depth to elucidate exactly how peer relatedness supported PA. The following three subthemes emerged: sharing a particular experience together, encouragement, and teamwork.

Comments reflecting sharing a particular experience together were evident in nine of the 10 interviews and occurred a total of 27 times across these interviews. Two key quotes from the interviews that reflected this subtheme included: *“I think we all just were, like, kind of on the*

same page, so I feel like I could relate to them in some way, even though they were probably might have been more active than me. I feel like we were all in, like, the same boat with that kind of stuff”, and “... it just helped knowing that there was someone that I could do it with that understood what I was trying to do or where I was trying to reach to.’

Encouragement from peers is the action of giving someone support, or helping them to increase their confidence to be physically active (Bandura, 1986). Statements related to this subtheme were noted in five of the 10 interviews and were evidenced a total of nine times. Examples of quotes indicating encouragement included “*..when I have other people cheering me on, it gets me to wanna work harder ‘cause I wanna make them proud too and help them out and everything*” and “*We’d always, like, kind of encourage each other to go do something and go out or do something.*”

Teamwork is the collaborative effort of the group to achieve the goal of being physically active (McEwan & Beauchamp, 2014). Responses regarding this subtheme emerged in three of the 10 interviews and occurred a total of five times across three interviews. Examples of quotes included “*..so I’m a big person for, like, teamwork and everything and motivating other people*”, and “*it was like teen stuff, so we like had —other people to work with and push us, and—.*” Teamwork was conveyed as a necessary component of a PA environment to support peer relatedness.

Theme 4. Additional helpful factors associated with an autonomy-supportive environment for PA. Participants also provided insight into other areas related to the intervention that they found were factors that helped them with their PA. As a result, four additional codes were created based on statements made in nine of the interviews. These codes included: fun (3 participants), fun competition (1 participant), habit formation (2 participants), and motivation (4

participants). Some of the quotes that supported these codes include: *“I had a lot of fun, and I know my friends had a lot of fun, and it was an amazing experience”* (fun), *“So it wasn’t super competitive where you’re getting frustrated at people, but it was that fun competitive”* (fun competitive), *“But now I’m kinda to the point where I know every day to go do it”* (habit), and *“Definitely the motivation because if I didn’t have the motivation, I might still do the things, but I just wouldn’t want to, and I wouldn’t have fun with it. And I definitely wouldn’t work out as hard”* (motivation). Developing PA interventions that are fun, create a positive competitive environment, assist in developing a habit of PA, and support motivation were noted as being important for assisting HS students to increase their PA.

Satisfaction with the PA intervention. Each of the following three PA intervention components was discussed in the interviews: (1) two face-to-face events, (2) daily avatar messages, and (3) weekly setting of PA goals and strategies. In addition, participants were asked about the instructors, barriers to participation in the PA intervention, and recommendations for improving the intervention.

Two face-to-face events. Ten of the 10 participants responded positively about the face-to-face events, and specifically enjoyed the opportunity to be with other teens who were interested in PA. One response that captured satisfaction with this component was: *“I liked how I could be with the other people inside the group and, kind of, like maybe not so get to know them better but just like be in their presence and be with them and, kinda, like just be there to encourage each other”*. Another comment was, *“I loved when we would, like, meet and do the physical activity together”*.

Daily avatar messages. All 10 participants discussed the daily avatar messages. A variety of feedback was provided. For example, the majority (n=8) of participants found the messages to

be helpful and made comments such as: *“It kind of gave me that extra push to work on stuff”* or *“I think the daily messages were definitely the most helpful”*.

Weekly PA goals and strategies. Ten of the participants discussed this component of the intervention. The majority (n=6) responded positively regarding having this component as a part of the intervention. One participant stated: *“They gave us more of, like, this is how you can achieve your goal, and this is what you should do to probably achieve your goal. But we still kind of had a little bit of freedom on it.”* Another said: *“it definitely helped so I didn’t have to come up with something on the spot.”* However, one participant commented that being self-driven is what makes her active; so the messages were not needed because she was already self-driven as indicated by statements such as: *“I didn’t, like, find an interest and it didn’t, like—I don’t know. I feel like if you’re not motivated—like, self-driven.”*

Instructors. Eight participants responded to questions about the instructors conducting the two face-to-face events. All eight participants indicated that the instructors had a positive impact on the intervention. Participants enjoyed having the instructors at the events to organize and support them. In addition, participants appreciated hearing instructors share their knowledge about PA. One participant stated: *“..like she’s just like so passionate about it, and she just knows so much about it. And I think hearing the strategies and tips coming from her, like someone who runs marathons and just is like so passionate about it, I think it’s just like so, like, eye-opening to hear.”* Another participant reported that *“they have more knowledge about this stuff than us, so they would give us that wise information. But they also had a lot of fun with us.”*

Barriers to participation. Participants were also asked about barriers that impacted their participation in the intervention. The six barriers that were identified included: technology (n=2), job (n=4), other activities (n=5), schoolwork (n=2), lack of transportation (n=1), and no ambition

to participate (n=2). Some of the supporting quotes for the barriers include: *“our internets, like, awful”* (technology), *“I work, like, every day after school”* (job), *“just people are always so busy”* (other activities), *“do my homework and stuff”* (schoolwork), *“I had no one to take me home”* (transportation), and *“just me, like, being lazy”* (no ambition to participate). Technology issues also consisted of students struggling with how to use the educational platform.

Recommendation for improving intervention. Participants were asked about ways to improve the intervention. The recommendations included: more face-to-face activities, fewer daily messages and times that messages are sent, and greater improvement of the avatars. Two participants thought that providing additional face-to-face events during the intervention would have increased motivation; both enjoyed being with others while they were active and did not have the skills to coordinate their own activities outside these events. Two participants stated that there could have been fewer messages and recommended the messages be sent every other day; or not on the same days that weekly goals and strategies were sent. They also felt that the timing of the messages should have been earlier in the day, versus at the end of the day. One participant discussed that the avatar seemed very robotic when delivering the message, and that greater choices regarding how to “dress” the avatar would have improved the appearance of the avatars. Additionally, a participant recommended demonstrating the educational platform where the messages were created at the face-to-face event, so students saw this process before trying to create a message on their own.

The autonomy-supportive environment dose could be increased by adding additional face-to-face events for the participants and was a supported idea by some participants in the intervention. There is little research related to dose of an autonomy-supportive environment that is needed in order to impact autonomous motivation for PA or the BPNs, by increasing the

frequency of the face-to-face events, improvement in autonomous motivation for PA may occur. Developing an app specific for HS students' PA could provide student specific PA education, students could choose the time and frequency of the messages, and the avatar could be enhanced to include teen components, providing more patient-centered education; this could accommodate the difference in how frequent participants wanted to receive messages and the timing could be specific to when the participants wanted to receive the messages. This could also enhance the technology component which some participants' struggled with.

Table 4.3: Categories & Themes, Number of Participants who Discussed, Number of References & Example Quotes

Category	Themes	Number of Participants who Discussed	Number of References in Interviews	Example Quote
Autonomy-supportive PA Environment	Autonomy	10	14	<i>"I liked how there were a bunch of different options, so you could kind of pick and choose what you wanted to do and what you liked to do".</i>
	Competence	10	11	
	Relatedness	10	48	<i>"..you had the things that you were familiar with, so you were confident—"</i> <i>"I feel like I made a lotta friends"</i>

Table 4.3: (cont'd)

Category	Themes	Number of Participants who Discussed	Number of References in Interviews	Example Quote
	Sharing an experience	9	27	<i>"... it just helped knowing that there was someone that I could do it with that understood what I was trying to do or where I was trying to reach to."</i>
	Encouragement	5	9	<i>"We'd always, like, kind of encourage each other to go do something and go out or do something."</i>
	Teamwork	3	5	<i>"..so I'm a big person for, like, teamwork and everything and motivating other people", and "it was like teen stuff, so we like had —other people to work with and push us,."</i>

Table 4.3: (cont'd)

Category	Themes	Number of Participants who Discussed	Number of References in Interviews	Example Quote
Satisfaction with PA Environment	Two face-to-face events	10	11	<i>"I loved when we would, like, meet and do the physical activity together".</i>
	Daily avatar messages	10	30	<i>"I think the daily messages were definitely the most helpful".</i>
	Weekly PA goals & strategies	10	13	<i>"It definitely helped so I didn't have to come up with something on the spot."</i>
	Barriers			
	Technology	2	3	<i>"our internets, like, awful"</i>
	Job	4	5	<i>"I work, like, every day after school"</i>
	Other Activities	5	10	<i>"just people are always so busy"</i>
	School Work	2	2	<i>"do my homework and stuff"</i>
	Lack of Transportation	1	1	<i>"I had no one to take me home"</i>
	No Ambition	2	2	<i>"just me, like, being lazy"</i>
	Recommendations	8	12	

Discussion

Schools and community organizations have been increasingly called upon to reverse declines in PA among adolescents (Centers for Disease Control and Prevention, 2017; WHO,

2020). One possible reason that achieving this objective has been difficult may be that PA interventions do not always incorporate perspectives of adolescents who participate in the interventions. A comprehensive evaluation from the adolescents who are participating in an intervention is essential to strengthen the intervention and increase the likelihood of improving PA in this age group. To meet this need a qualitative thematic analysis methodology was used to understand the perceptions of HS students who participated in a PA intervention. Specifically, individual interviews were mainly conducted to explore the participants' perceptions related to: (1) the provision of an autonomy-supportive environment, and (2) their satisfaction with the PA intervention.

Autonomy can be created by providing choice in the type of PA adolescents participate in (Ryan & Deci, 2017). Students emphasized that choice was evident at the two face-to-face events because there were a variety of activities to participate in and they were informed that leisure time PA was any type of PA they wanted to participate in. Competence is developed by starting with easier skills and then advancing the skills as an adolescent gains confidence in the easier tasks (Ryan & Deci, 2017). Students described how they liked participating in activities that they were “good” at and had the necessary skills to be successful in performing the activities. Research has shown that competence has a strong, positive association with participation (Timo et al., 2016). Relatedness in PA is perceived when an adolescent feels socially connected to significant people (Alali et al., 2020). For this young population, peers are essential. Having a similar experience and acquiring support from those who are going through the same experience have been shown to improve PA outcomes (Fitzgerald et al., 2012). This study's results suggest that relatedness can be supported in a variety of ways from peers, similar to findings of other studies (Fitzgerald et al., 2012; Macdonald-Wallis et al., 2012). In a systematic review,

Fitzgerald et al. (2012) identified several ways in which peers can influence PA: peer social support (e.g., friends/peers participating in PA, encouragement from peers during PA, peer modeling of PA), presence of peers during PA, peer norms (e.g., perceptions of peers' approval of PA), friendship quality, and peer affiliation to certain groups (e.g., PA groups that provide a sense of identity). The Fitzgerald et al. (2012) review indicated that researchers interested in testing a PA intervention must capitalize on the importance of peer relatedness in their studies. In the PA intervention study conducted by the authors that included rural adolescents peer relatedness provided a fruitful strategy to improve the autonomy-supportive environment (Fitzgerald et al., 2012; Macdonald-Wallis et al., 2012). According to Ryan and Deci (2017), autonomy-supportive environments increase adolescents' autonomous motivation for PA; and as a result, these environments can improve PA outside the intervention (Ryan & Deci, 2017). The current study's findings also support that HS students enjoy and need an autonomy-support environment to improve their PA.

Overall, the current study was able to demonstrate that through a variety of approaches (e.g., face-to-face events, technology with daily avatar motivational messages, and weekly PA goals and strategies), HS students overall were satisfied with the PA intervention. Adolescents are at a developmental stage that is characterized by this group wanting to have choices for their PA behavior, feel successful when engaging in their chosen PA behavior, and have others involved that they enjoy being with and can connect to when participating in PA (Nicaise & Kahan, 2013; Owen, Astell-Burt, & Lonsdale, 2013). Receiving input from adolescents will assist school nurses and researchers in more effectively advocating for programs and partnering with community agencies to promote PA in rural, adolescents.

The face-to-face event provided an opportunity for the HS students to be with other peers who enjoyed PA (Fitzgerald et al., 2012). The event also provided skill building session that enhanced PA skills for the participants (Timo et al., 2016). By provided an opportunity of activities at the events, students were satisfied and felt they were able to be active during the entire event. Although these two opportunities were an important part of the intervention, some students indicated that additional face-to-face sessions would improve the program. However, adolescents' attendance at these events was less than 50% due to barriers like school work, job, and other commitments. Events that occur on a regular basis (monthly throughout the school year) might make it easier for participants to plan ahead.

Adolescents identified that the avatar of their peers sending motivation messages was an innovative way to help them perceive that they had an autonomy-supportive environment outside the face-to-face events. Using avatars, which are graphical representations of users in a variety of electronic environments (Biocca, 1997; Minjin, Jang, & Peng, 2020) has been identified as a viable approach to improve health outcomes via technology. Minjin, Jang and Peng's (2020) systematic review on health interventions using avatars to enhance healthy behaviors (specifically healthy eating and PA) included 18 studies. The results of the review showed that using an avatar that is physically active, fit, and similar in appearance to the user is an effective way to improve health behavior. In the current study, HS students viewed the support received from several peers, all of whom were similar in age, as being beneficial. The HS students also indicated that this approach can be used to successfully develop an autonomy-supportive environment via technology.

The weekly PA goals and strategies were also a good reminder for the participants related to what they were working on and ways to support their PA. They liked creating the avatar who

sent the messages. They also thought the goals were realistic, and strategies were helpful. This information highlights the importance of having adolescents set goals and providing support for their PA. One way to improve the program, would be to avoid sending a daily message on the days that the weekly PA goals and strategies were sent out. This strategy would decrease the number of messages and help give participants to focus during a specific week.

Adult instructors who create an autonomy-supportive PA environment can improve PA outcomes, as demonstrated in a variety of PE environments (Babic et al., 2016; Ha et al. 2017; Kerner & Goodyear, 2017; Lonsdale et al. 2013; Nation-Granger, 2017; Perlman, 2013). The trained instructors for the intervention associated with this qualitative study were able to successfully maintain an autonomy-supportive environment, and participants acknowledged that the adults leading and organizing the face-to-face event contributed to its success. Participants enjoyed acquiring knowledge from the information provided by the instructors and appreciated the encouragement from the instructors at the two events.

Similar to another study (Eime et al., 2010), students identified various barriers to participating in the intervention that included: school work obligations, having jobs that took time away from attending the face-to-face events or reading messages, and technology (Eime et al., 2010). Students suggested that scheduling the face-to-face events more in advance and on a regular basis would allow them to plan ahead and prevent conflicts. Avoiding conducting events during busy times of the school year was another strategy suggested by the HS students. Some students felt that having a better Internet connection in rural areas was important, and that slower services interfered at times with their ability to listen to the daily or weekly messages. One student also suggested that the technology involving the avatars needed to improve by making the avatars less robotic and a truer representation of teens.

Limitations and Future Research Directions

This study has limitations. Due to the first author seeking only HS students who were willing to participate, perceptions of adolescents who are not motivated to be active may not be represented. However, this work represents an ongoing and important area of intervention research and can contribute to improvements in future quantitative studies that test interventions to increase MVPA in a large sample. This type of innovative work can assist investigators and practitioners interested in developing a program that utilizes technology for creating an autonomy-supportive environment to develop adolescents' autonomous motivation for PA. Another limitation is that adolescents without a cell phone were not included in the study. Therefore, future research should explore ways to include adolescents from lower socioeconomic groups with limited resources. Lastly, adolescents' responses may be biased because they did not want to express any negative comments about the intervention and so they consistently responded in a positive manner in the interviews.

Implications for School Nurses

This study lays a foundation for the continued development of a program of innovative research based on the perspectives of adolescents. School nurses play a critical role in advocating for health promotion in schools. One area of health promotion involves increasing PA to prevent chronic health conditions. School nurses also play a key role in building collaborative partnerships within the community to find resources to promote the health for adolescents. Collaborative partnerships that promote PA in adolescents can help to address the issues of adolescent overweight and obesity that can have detrimental health outcomes for the adolescent population (Dishman et al., 2018; National Alliance of Youth Sports, 2018; Oluwasanu & Oladepo, 2017; Reinehr, 2018).

Schools and communities can provide innovative PA interventions to support the PA of adolescents, but should seek and include valuable feedback from them first. Because PA is key to preventing many chronic health conditions, inadequate PA among students is a serious concern for school nurses (Cowell, 2014). School nurses, however, are in a prime position to support community efforts and to even initiate and facilitate collaborative partnerships between community organizations, school administrators, and parents. By acknowledging the diversity and unique perspectives of adolescents, nurses working in schools can transform practice to improve the PA levels of adolescents in their respective communities.

REFERENCES

- Aelterman, N., Vansteenkiste, M., Soenens, B., & Haerens, L. (2016). A dimensional and person-centered perspective on controlled reasons for non-participation in physical education. *Psychology of Sport Exercise*, 23: 142-154.
- Alali, M. A., Robbins, L. B., Ling, J., Kao, T.-S. A., & Smith, A. L. (2020). Concept analysis of relatedness in physical activity among adolescents. *Journal of Pediatric Nursing*. doi: org/10.1016/j.pedn.2020.06.005
- Babic, M. J., Smith, J. J., Morgan, P. J., Lonsdale, C., Plotnikoff, R. C., Eather, N., . . . Lubans, D. R. (2016). Intervention to reduce recreational screen-time in adolescents: Outcomes and mediators from the ‘Switch-Off 4 Healthy Minds’ (S4HM) cluster randomized controlled trial. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 91, 50-57. doi.org/10.1016/j.ypmed.2016.07.014
- Bandura, A., & National Inst of Mental Health. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Inc.
- Beets MW, Beighle A, Erwin HE, Huberty JL. (2009). After-school program impact on physical activity and fitness: A meta-analysis. *American Journal of Preventive Medicine*;36(6):527-537. doi:10.1016/j.amepre.2009.01.033
- Biocca, F.(1997). The cyborg’s dilemma: Progressive embodiment in virtual environments. *Journal of Computer Mediat Communications* 1997; 3:JCMC324.
- Braun V., Clarke V. Using thematic analysis in psychology. *Qual. Res. Psychol.* 2006;3:77–101. doi: 10.1191/1478088706qp063oa.
- Centers for Disease Control and Prevention. 2019, Youth Risk Behavior Survey Questionnaire. Available at: www.cdc.gov/yrbs. Accessed on July 10, 2020.
- Cowell, J. M. (2014). Physical activity in schools: Challenges for school nursing. *The Journal of School Nursing*, 30, 9–10. doi: 10.1177/1059840513516930
- De Meester, A., Cardon, G., DeBourdeaudhuij, I., & Haerens, L.(2017). Extracurricular school-based sports as a stepping stone toward an active lifestyle? Differences in physical activity and sports-motivation between extracurricular school-based sports participants and non-participants. *Journal of Teaching in Physical Education* 36(4), 485-497.
- Dishman, R., McIver, K., Dowda, M., & Pate, R. (2018). Declining physical activity and motivation from middle school to high school. *Medicine & Science in Sports & Exercise*, 50(6), 1206-1215. doi:10.1249/MSS.0000000000001542

- Eime R., Payne, W., Casey, M., & Harvey, J. (2010). Transition in participation in sport and unstructured physical activity for rural living adolescent girls. *Health Education Research*, 25(2), 282-93.
- Fitzgerald A, Fitzgerald N, Aherne C. (2012). Do peers matter? A review of peer and/or friends' influence on physical activity among American adolescents. *Journal of Adolescents*; 35:941–58. 10.1016/j.adolescence.2012.01.002
- Fynn, J. F., Hardeman, W., Milton, K., Murphy, J., & Jones, A. (2020). A systematic review of the use and reporting of evaluation frameworks within evaluations of physical activity interventions. *The international journal of behavioral nutrition and physical activity*, 17(1), 107. <https://doi.org/10.1186/s12966-020-01013-7>
- Fortier MS, Duda JL, Guerin E, Teixeira PJ. (2012). Promoting physical activity: development and testing of self-determination theory-based interventions. *International Journal of Behavior Nutrition Physical Activity*;9:20. 10.1186/1479-5868-9-20
- Glesne, C. (2011). *Becoming qualitative researcher: An introduction*. (4th ed.). Boston, MA: Pearson.
- Ha, A. S., Lonsdale, C., Ng, J. Y. Y., & Lubans, D. R. (2017). A school-based rope skipping program for adolescents: Results of a randomized trial. *Preventive Medicine*, 101, 188-194. doi:10.1016/j.ypmed.2017.06.001
- Heath, G. W., Parra, D. C., Sarmiento, O. L., Andersen, L. B., Owen, N., Goenka, S., Montes, F., Brownson, R. C., & Lancet Physical Activity Series Working Group (2012). Evidence-based intervention in physical activity: lessons from around the world. *Lancet (London, England)*, 380(9838), 272–281. [https://doi.org/10.1016/S0140-6736\(12\)60816-2](https://doi.org/10.1016/S0140-6736(12)60816-2)
- Kerner, C., & Goodyear, V. (2017). The motivational impact of wearable healthy lifestyle technologies: A self-determination perspective on fitbits with adolescents. *American Journal of Health Education*, 48(5), 287-297. doi: 10.1080/1932503712017.1343161
- Loescher LJ, Rains SA, Kramer SS, Akers C, Moussa R. A Systematic Review of Interventions to Enhance Healthy Lifestyle Behaviors in Adolescents Delivered via Mobile Phone Text Messaging. *Am J Health Promot*. 2018;32(4):865–879. doi:10.1177/0890117116675785
- Lonsdale, C., Rosenkranz, R. R., Sanders, T., Peralta, L. R., Bennie, A., Jackson, B., . . . Lubans, D. R. (2013). A cluster randomized controlled trial of strategies to increase adolescents' physical activity and motivation in physical education: Results of the Motivating Active Learning in Physical Education (MALP) trial. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 57(5), 696-702. doi:<http://dx.doi.org/10.1016/j.ypmed.2013.09.003>

- Lubans, D., & Morgan, P. (2008). Evaluation of an extra-curricular school sport programme promoting lifestyle and lifetime activity for adolescents. *Journal of Sports Science*, 26(5), 519-529. doi:10.1080/02640410701624549
- Macdonald-Wallis, K., Jago R., & Sterne, J.A. (2012). Social network analysis of childhood and youth physical activity: A systematic review. *American Journal of Preventive Medicine*, 43:636–42. 10.1016/j.amepre.2012.08.021
- McEwan, D. & Beauchamp, M.R. (2014) Teamwork in sport: A theoretical and integrative review, *International Review of Sport and Exercise Psychology*, 7:1, 229-250.
- Minjin, R., Jang, Y., & Peng, W. (2020). *Games for Health Journal*, 85-94. <http://doi.org/10.1089/g4h.2018.0134>
- Nation-Grainger, S. (2017). "It's Just PE 'till' It Felt Like a Computer Game": Using technology to improve motivation in physical education. *Research Papers in Education*, 32(4), 463-480. doi:<http://dx.doi.org/10.1080/02671522.2017.1319590>
- Nicaise, V. & Kahan, D. (2013). Psychological changes among Muslim students participating in a faith-based school physical activity program. *Research Quarterly for Exercise & Sport*, 84(4), 522-529.
- Oluwasanu, M. & Oladebo, O. (2017). Effects of a multi-level intervention on the pattern of physical activity among in-school adolescents in Oyo state Nigeria: A cluster randomized trial. *BMC Public Health* 17: 1-11.
- Owen, K., Smith, J., Lubans, D., Ng, J., & Lonsdale, C. (2014). Self-determined motivation and physical activity in children and adolescents: A systematic review and meta-analysis. *Preventive Medicine*, 67, 270-279. doi:10.1016/j.ypmed.2014.07.033
- Perlman, D. (2013). The influence of the social context on students in-class physical activity. *Journal of Teaching in Physical Education*, 32(1), 46-60. doi:<http://dx.doi.org/10.1123/jtpe.32.1.46>
- Reinehr, T. (2018). Long term effect of obesity: Time to act. *Nature Reviews Endocrinology*, 14. doi: 10.1038/nrendo.2017.147
- Ryan, R., & Deci, E. (2017). Self-Determination theory. Basic psychological needs in motivation, development, and wellness. Guilford Press, New York, London.
- Standage, M., Duda, J.L., & Ntoumanis, N.(2005). A test of self-determination theory in school physical education. *British Journal of Education Psychology*, 75:411–33. 10.1348/000709904X22359

- Teixeira, P.J., Carraça, E.V., Markland, D., Silva, M.N., & Ryan, R.M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavior Nutrition Physical Activity*, 9:78. 10.1186/1479-5868-9-78
- Thompson, D., Deatrick, J. A., Knafl, K. A., Swallow, V. M., & Wu, Y. P. (2022). A Pragmatic Guide to Qualitative Analysis for Pediatric Researchers. *Journal of pediatric psychology*, jsac040. Advance online publication. <https://doi.org/10.1093/jpepsy/jsac040>
- Timo, J., Sami, Y. P., Anthony, W., & Jarmo, L. (2016). Perceived physical competence towards physical activity, and motivation and enjoyment in physical education as longitudinal predictors of adolescents' self-reported physical activity. *Journal of science and medicine in sport*, 19(9), 750–754. <https://doi.org/10.1016/j.jsams.2015.11.003>
- U.S. Department of Health and Human Services. National Youth Sports Strategy. Washington, DC. U.S. Department of Health and Human Services; 2019.
- World Health Organization (2018). Global strategy on diet, physical activity and health. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_young_people/en/ on August 2020.
- Yousefian Hansen, A. & Hartley, D. (2015). Promoting Active Living in Rural Communities. San Diego, CA: Active Living Research. Available at www.activelivingresearch.org.

CHAPTER FIVE: CONCLUSIONS

The importance of developing effective theory-based interventions for rural high school (HS) students is evident. Health disparities exist between rural and urban residents with rural residents having higher rates of chronic disease and obesity (Umstaad et al., 2016). Youth Risk Behavior Survey (YRBS, 2019) data indicate that only 23.2% of all students surveyed had been physically active for ≥ 60 minutes/day on all seven days per week, less than half (49.5%) had exercised to tone or strengthen muscles on ≥ 3 days/week, and just 16.5% had met both aerobic and muscle strengthening physical activity (PA) guidelines (YRBS, 2019). The trends in the data related to PA behavior in the HS population show limited improvement, and, in some cases, a progressive worsening over time (Merlo et al., 2020). PA is needed for optimal growth and development and the prevention of chronic health conditions. Chronic health conditions affect half of the adults in the United States (US) and lead to increased health care costs, decreased productivity, and decreased quality of life. Some chronic health conditions, including cardiovascular disease, type 2 diabetes, and obesity, can be prevented by engaging in health-promoting behaviors, such as PA (Merlo et al., 2020). A habit of attaining adequate PA during adolescence can carry over into the adult years and is important for preventing the chronic health conditions known to exist in rural populations. Therefore, assisting adolescents to attain adequate PA is a vital public health priority for promoting lifelong physical health (Centers for Disease Control and Prevention, 2017).

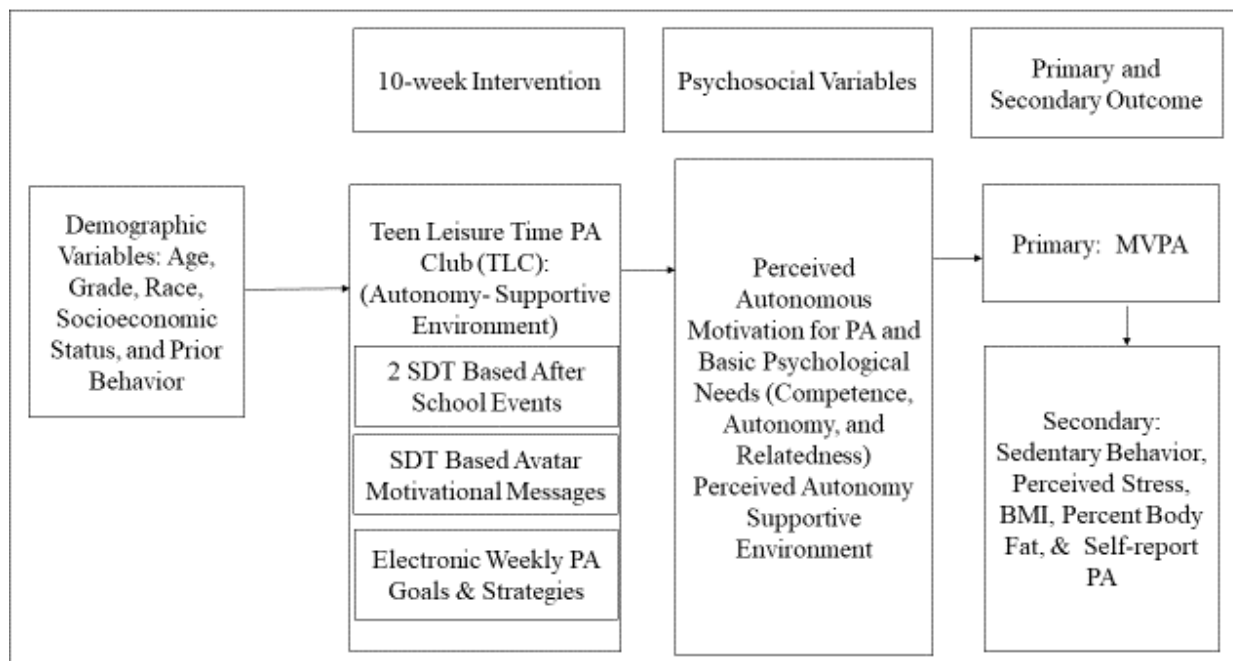
Research supports that the after-school setting is ideal for implementing PA interventions, as previous after-school PA interventions have had a moderate effect on PA (SMD=.44; Beets et al., 2009; Heath et al., 2012). However, only one study including an after-school intervention was found that included HS students, and this study was not conducted with

a rural population (Lubans & Morgan, 2008). Another approach that is lacking in the extant literature is the use of autonomy-supportive PA environments in after-school setting for HS students. An autonomy-supportive environment that provides support for the basic psychological needs (BPNs; competence, autonomy, and relatedness) can move motivation along the motivation continuum in a positive direction (Gillison et al., 2009; Mouratidis & Michou, 2011). Unfortunately, little is known about after-school programs that utilize autonomy-supportive environments to improve moderate-to-vigorous PA (MVPA) in rural adolescents. Thus, the purpose of this quantitative and qualitative dissertation was a concept analysis of adolescent autonomous motivation for PA and then was to implement an after-school PA club for rural HS students utilizing a theory-based autonomy-supportive environment through face-to-face events and technology-based methods.

Model Linkage

Deci and Ryan's (2008) Self-determination Theory (SDT) served as a framework for understanding how to design and implement the intervention, including the after-school PA club, for rural HS students. A model was developed that included demographic variables (age, grade, race, socioeconomic status, and prior behavior), autonomy-supportive environment (competence, autonomy, and relatedness), perceived autonomous motivation for PA, perceived autonomy-supportive environment, and the primary outcome (MVPA), and secondary outcomes (sedentary behavior, perceived stress, body mass index [BMI], percent body fat [%BF], and self-report PA). This study focused on examining these factors (see Figure 5.1) in the quantitative and qualitative phases of this dissertation to address specific research questions in each of the three manuscripts.

Figure 5.1 Teen Leisure Time Physical Activity Club/Operational Model



This dissertation utilized the three-manuscript format. Manuscript 1 (Chapter 2) was a concept analysis of adolescent autonomous motivation for PA that was guided by Rodgers Evolutionary Method (Rodgers, 2000). Manuscript 2 (Chapter 3) was a quantitative intervention study that examined the feasibility, acceptability, and effectiveness of the intervention on the primary outcome (MVPA) and secondary outcomes (sedentary behavior, perceived stress, BMI, %BF, and self-report PA). Manuscript 3 (Chapter 4) utilized a qualitative approach to explore participants' feelings related to the autonomy-supportive PA environment and their satisfaction with the PA intervention. Overall, this dissertation provides some evidence of the continued need to create an autonomy-supportive PA environment in PA interventions for HS students. Utilizing a combination of face-to-face and technology-based approaches in interventions to create this type of environment may be promising for improving PA outcomes among rural HS students.

Overview of Manuscript 1

Information is lacking on whether a theory-based autonomy-supportive PA environment with daily peer delivered avatar motivational messages and weekly PA goals and strategies can impact autonomous motivation for PA and PA levels in rural HS students. However, little work has been conducted to clearly define the concept of adolescent autonomous motivation for PA. Therefore, the concept of adolescent autonomous motivation for PA was analyzed in Manuscript 1. Manuscript 1 included an examination of the use and meaning of adolescent autonomous motivation for PA in the literature. Similarities and differences were noted. The primary aim was to present an analysis of the concept of autonomous motivation for PA by identifying its defining attributes, related concepts/surrogate terms, antecedents, and consequences. During the literature review, the following two limitations were noted: (1) the literature mentioned autonomous motivation, but a conceptual definition was not clearly or consistently provided, and (2) a variety of empirical measures were used to measure the concept in different research studies. However, the concept analysis resulted in several important key findings as follows: (1) two defining attributes of autonomous motivation for PA are being dynamic and on a continuum, (2) antecedents include an autonomy-supportive environment and positive perceptions of PA, and (3) adolescent autonomous motivation for PA is the self-desire to be active because PA is fun, and enjoyable, or PA is part of how the adolescent maintains a healthy lifestyle and part of who the adolescent identifies as being (as being an athlete or healthy; Palmer et al., 2020). In addition, this concept analysis provided an important foundation for using an autonomy-supportive environment in the PA intervention for the rural HS students to fill the gaps in understanding regarding what components and dose of an autonomy-supportive environment are needed to increase PA in this young population. Hence, the use of Rodgers (2000) model to explain what

adolescent autonomous motivation for PA is what led to the work noted in the subsequent manuscripts of this dissertation that also focused on addressing the gaps in research. This manuscript on the concept analysis was published in the *Journal of Pediatric Nursing* in May 2020.

Overview of Manuscript 2

The literature identified in Manuscript 1 justified the use of the SDT (Deci & Ryan, 2008) in this area of research, which led to Manuscript 2 of this dissertation. Manuscript 2 is the quantitative result of a 10-week intervention study with rural HS students to examine the feasibility, acceptability, and preliminary efficacy of intervention on the targeted primary and secondary outcomes. Students (ages 14-18) who were living in a rural community were willing to participate in the study, understood written and spoken English, and had a cell phone that could be used during the intervention were recruited. Adolescents participated in the 10-week PA intervention, which included two face-to-face events, daily SDT text messages via an avatar, and weekly PA goals and strategies sent to the participants. Data were collected from the participants prior to the intervention and immediately after the end of the intervention.

This study is the first to use electronic SDT-based, peer-delivered avatar motivational messages plus weekly PA goals and PA strategies in combination with two after-school events (reflecting an autonomy-supportive environment) to increase MVPA among rural HS students. Capitalizing on research demonstrating the importance of focusing on the BPNs, particularly peer relatedness (Saez et al., 2018; Sebire et al., 2018), a novel, fun, and engaging way for HS students to increase their MVPA was developed. This theory-based approach included an autonomy-supportive environment uniquely designed to meet HS student's BPNs as a means to directly increase their autonomous motivation for PA. Whether autonomous motivation for PA

can be increased through an autonomy-supportive PA environment and then lead to increase MVPA among rural adolescents has been basically unknown prior to this study.

Gaps in knowledge related to PA interventions for adolescents of HS age, particularly those living in rural areas are evident. The limited research conducted with this population is a major concern because a sharp decline in MVPA occurs with increasing age across adolescence, clearly indicating that this developmental period is a prime time for implementing interventions (Oluwasanu & Oladepo, 2017; Reinehr, 2018). Assisting adolescents to attain adequate PA is essential because increased levels of PA have been associated with improvements in BMI and %BF, and reductions in sedentary behavior and stress in this population.

Recognizing the urgent need to intervene with HS students, researchers have developed and tested PA interventions focusing on physical education (PE) and school environmental change (e.g., increasing MVPA during PE and active classrooms; Babic et al., 2016; Ha et al. 2017; Kerner & Goodyear, 2017; Lonsdale et al. 2013; Nation-Granger, 2017; Perlman, 2013). Unfortunately, these prior school-based interventions have resulted in either no or minimal improvement in MVPA and its maintenance. One plausible reason is that the approaches failed to assist HS students in increasing their autonomous motivation for PA. One barrier to implementation is that these interventions require intensive resources and time in an already full academic schedule. Utilizing the time after school rather than during school to assist HS students to increase their MVPA, may potentially be less resource-intensive and more feasible for improving adolescent autonomous motivation for PA and the behavior itself.

Therefore, the operational model (see Figure 5.1) components that were evaluated in Manuscript 2 included: (1) ***demographic variables***, (2) ***adolescent autonomous motivation for PA***, (3) ***perceived autonomy-supportive environment***, (4) ***primary outcome***, and (5) ***secondary***

outcomes. Adolescent demographic variables were collected to describe the diversity of demographics among the sample and to examine any influence on the outcomes. Data on adolescent autonomous motivation for PA and perceived autonomy-supportive environment were collected pre- and post-intervention to determine if changes occurred. Primary and secondary outcome data were also collected pre- and post-intervention to evaluate the preliminary efficacy of the intervention. Data were collected via ActiGraph (GT3X+ and GT3X-BT) and self-report to assess adolescents' PA levels; measures to examine their perceptions of autonomous motivation for PA, perceptions of an autonomy-supportive PA environment, perceived stress, sedentary behavior and anthropometric measures (i.e., height, weight for BMI and %BF). Overall, this manuscript not only extended the science, but also provided information on the feasibility and acceptability of this type of intervention and further exploration of the SDT (Deci & Ryan, 2008) components through an intervention study with rural HS students. Ensuring that samples are comparable at baseline, especially on variables that impact PA (like BMI and %BF) will provide populations with similar perceptions at the start of the study. With some modifications to the intervention, and an adequate sample size, efficacious results could be achieved.

Overview of Manuscript 3

The SDT (2017) guided Manuscript 3, the qualitative study aim to explore rural HS students' experiences and perceptions with a multi-component, after-school PA intervention. Based on the SDT, the BPNs were further explored with the participants to assess their perceptions related to an autonomy-supportive environment and their satisfaction with the PA intervention (see Figure 5.1).

Manuscript 3 utilized semi-structured interviews to explore specific areas of inquiry about the intervention. A subsample of intervention participants were selected as potential participants for the qualitative study. Demographic information was provided by participants prior to the intervention beginning and those selected completed informed consent/assent. A semi-structured telephone interview using Zoom© technology for recording was conducted with HS students (see Appendix). An interview guide with prompts was used to elicit information from participants regarding their experiences in the following areas: (1) ***participant satisfaction with the intervention***, and (2) ***perceptions of an autonomy-supportive environment***. This manuscript represented a unique approach to advancing the science through a more structured lens to provide an in-depth understanding of what adolescents perceive regarding this specific type of PA intervention. This study lays the foundation for the continued development and future enhancement of an intervention utilizing an autonomy-supportive environment to support the autonomous motivation of adolescents, and improve their MVPA. By acknowledging the diversity and unique perspectives of rural HS students, nurses can transform practice and intervene to support this young population in attaining adequate MVPA.

Limitations of the Overall Dissertation

This dissertation has several limitations. In Manuscript 1, due to the limited number of qualitative studies, the concept analysis may not fully reflect adolescents' own perspectives. In addition, relationships of autonomous motivation with objectively measured and self-reported PA outcomes may not be comparable because of the differences in PA measures and self-reported bias derived from social desirability. Further, the racial or ethnic diversity, size, age, gender, socioeconomic status, and prior PA of the samples were inconsistently reported across studies. Sample sizes varied widely across the studies, with no study justifying the selected

sample size. Most studies incorporated descriptive cross-sectional designs and included participant self-report of PA. Also, varied measures of autonomous motivation of PA were used. Lastly, although grey literature was assessed in multiple database, it is possible that some studies were not accessed utilizing the key search terms. These issues limited the findings in Manuscript 1.

In Manuscripts 2 and 3, the quantitative and qualitative studies had limited external validity because the intervention may not be generalizable to other populations (e.g., urban or adult populations). Another possible limitation is that the adolescents' responses may be biased because they did not want to express any negative aspects about the study and so they responded positively for the sake of the study. The accelerometer does have some disadvantages worth noting, such as its inability to accurately estimate some activities (e.g., stationary biking and elliptical activity) because accelerometer equations are developed for walking and running (PA Resource Center for Public Health, 2020). HS students who choose to participate may not be representative of those not meeting MVPA recommendations, and HS students who do not choose to participate may be less motivated.

Implications of Overall Dissertation

Intervention studies related to PA among rural HS students are lacking. This research study contributes toward filling the gap in knowledge by testing a PA intervention with rural HS students. This population has high levels of stress (Euler et al., 2019; Johnson & Johnson, 2015) due to high academic expectations, difficulties with peer relationships, and challenges associated with living in a rural area (e.g., poverty, distance; Stults-Kolehmainen, & Sinha, 2014). HS students who are not meeting the recommended levels of MVPA (≥ 60 min/day of mostly MVPA) usually have high sedentary behavior (Must & Tybor, 2005). Increasing rural HS

students' MVPA and reducing their sedentary behavior is critical for increasing the brain's resistance to stress (Ratey & Hagerman, 2008) and preventing adverse chronic health conditions, such as obesity, hypertension, and diabetes. This study provides a foundation for conducting future studies directed toward enhancing autonomous motivation for PA among rural HS students. Rural HS students who do not participate in programs that promote adequate MVPA are particularly in urgent need of effective theory-based interventions (Pate, Flynn & Dowda, 2016).

Nursing Education and Research. Findings from this dissertation can be applied to promote excellence in nursing education and research by preparing a future nursing workforce with some knowledge needed to support rural HS students' PA participation. This work contributes to the profession of nursing by educating nursing colleagues and the next generation of nurses about novel ways to create autonomy-supportive environments to increase adolescents' autonomous motivation for PA and address their BPNs. Additionally, the three manuscripts presented in this dissertation can assist with translating this type of research to a variety of health care settings where nurses practice such as schools, public health, and school-based health centers. Findings can also be used by after-school program staff to strengthen PA programs.

The knowledge gained from this research can be used to help rural US students increase their MVPA to assist them in both achieving or maintaining a healthy weight and managing their stress to improve their overall health. For instance, conducting similar intervention research could potentially further elucidate ways to engage adolescents in PA clubs and improve autonomous motivation for lifelong engagement in a positive health behavior. A comprehensive understanding of peer relatedness can contribute to the development of novel strategies to enhance this BPN in PA interventions. For this dissertation, quantitative and qualitative data

were collected to evaluate an innovative intervention that has never yet been tested with rural HS students to increase their MVPA. This study is expected to provide an important foundation that leads to development of school and community-based PA programs to promote the health of adolescents in rural communities throughout the US. Attaining adequate PA during adolescence has numerous positive physical and mental health benefits, some of which include preventing weight gain, reducing body fat, increasing cardiorespiratory and musculoskeletal fitness, reducing risk factors for chronic diseases in adulthood, and decreasing stress. This evidence highlights the need to promote opportunities for PA for rural adolescents.

Policy. HS students, especially those living in rural communities, face unique challenges, and the three manuscripts in this dissertation highlight the need for autonomy-supportive PA interventions for this population. Policies are needed to reduce the barriers that rural HS students face in accessing PA opportunities. Many rural communities lack adequate facilities for this population to be active in and communities need additional resources to develop the infrastructure that would allow year round participation. Policies at the state and federal level that would support this type of funding would benefit this population. School wellness policies, after-school programs, and PE courses should also consider utilizing autonomy-supportive PA environments in programs that support PA. This dissertation emphasizes the important role that the BPNs, particularly peer relatedness, play with regard to HS students' PA. In addition, this dissertation underscores the need for an autonomy-supportive environment to help them increase their leisure time PA. National organizations, such as the National Association of School Nurses, Action for Healthy Kids, National Rural Health Association, and the American Heart Association recognize the barriers and disparities in the health of adolescents who reside in rural communities. Unfortunately, limited research funding is available to test and creative approaches

for addressing these barriers that this population continues to face (PA Resource Center for Public Health, 2020). Hence, additional policies that support increased funding for research to increase PA among HS students in these communities are urgently needed.

Conclusions

In summary, this qualitative and quantitative dissertation study, which was guided by the established SDT, contributes to filling the gap in research on theory-based PA interventions for rural HS students. Findings will be useful for strengthening the design of a future PA intervention for HS students that can be tested in large-scale randomized controlled trial.

REFERENCES

- Babic, M. J., Smith, J. J., Morgan, P. J., Lonsdale, C., Plotnikoff, R. C., Eather, N., . . . Lubans, D. R. (2016). Intervention to reduce recreational screen-time in adolescents: Outcomes and mediators from the ‘Switch-Off 4 Healthy Minds’ (S4HM) cluster randomized controlled trial. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 91, 50-57. doi.org/10.1016/j.ypmed.2016.07.014
- Beets MW, Beighle A, Erwin HE, Huberty JL. (2009). After-school program impact on physical activity and fitness: A meta-analysis. *American Journal of Preventive Medicine*;36(6):527-537. doi:10.1016/j.amepre.2009.01.033
- Centers for Disease Control and Prevention. (n.d.). Gateway to health communication & social marketing impact (2017). Retrieved from <https://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/PhysicalInactivity.html>
- Centers for Disease Control and Prevention. (2017) Youth Risk Behavior Survey Questionnaire. Available at: www.cdc.gov/yrbs. Accessed on November 4, 2019
- Deci, E., and Ryan, R. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, 49(3). 182-5.
- Euler R, Jimenez EY, Sanders S, Kuhlemeier A, Van Horn ML, Cohen D, et al. (2019). Rural–urban differences in baseline dietary intake and physical activity levels of adolescents. *Preventing Chronic Disease*;16:180200. doi.org/10.5888/pcd16.180200
- Gillison, F., Osborn, M., Standage, M., & Skevington, S. (2009). Exploring the experience of introjected regulation for exercise across gender in adolescence. *Psychology of Sport & Exercise*, 10(3), 309-319.
- Ha, A. S., Lonsdale, C., Ng, J. Y. Y., & Lubans, D. R. (2017). A school-based rope skipping program for adolescents: Results of a randomized trial. *Preventive Medicine*, 101, 188-194. doi:10.1016/j.ypmed.2017.06.001
- Heath, G. W., Parra, D. C., Sarmiento, O. L., Andersen, L. B., Owen, N., Goenka, S., Montes, F., Brownson, R. C., & Lancet Physical Activity Series Working Group (2012). Evidence-based intervention in physical activity: lessons from around the world. *Lancet (London, England)*, 380(9838), 272–281. [https://doi.org/10.1016/S0140-6736\(12\)60816-2](https://doi.org/10.1016/S0140-6736(12)60816-2)
- Johnson, J. A., 3rd, & Johnson, A. M. (2015). Urban-rural differences in childhood and adolescent obesity in the United States: a systematic review and meta-analysis. *Child Obesity*, 11(3), 233-241. doi:10.1089/chi.2014.0085

- Kerner, C., & Goodyear, V. (2017). The motivational impact of wearable healthy lifestyle technologies: A self-determination perspective on fitbits with adolescents. *American Journal of Health Education*, 48(5), 287-297. doi: 10.1080/1932503712017.1343161
- Lonsdale, C., Rosenkranz, R. R., Sanders, T., Peralta, L. R., Bennie, A., Jackson, B., . . . Lubans, D. R. (2013). A cluster randomized controlled trial of strategies to increase adolescents' physical activity and motivation in physical education: Results of the Motivating Active Learning in Physical Education (MALP) trial. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 57(5), 696-702. doi:http://dx.doi.org/10.1016/j.ypmed.2013.09.003
- Lubans, D., & Morgan, P. (2008). Evaluation of an extra-curricular school sport program promoting lifestyle and lifetime activity for adolescents. *Journal of Sports Science*;26(5):519-529. doi:10.1080/02640410701624549
- Merlo CL, Jones SE, Michael SL, et al. (2019). Dietary and physical activity behaviors among high school students — youth risk behavior survey, United States, 2019. *MMWR Supplement* 2020;69(Suppl-1):64–76. DOI: <http://dx.doi.org/10.15585/mmwr.su6901a8>
- Mouratidis, A. & Michou, A. (2011). Perfectionism, self-determined motivation, and coping among adolescent athletes. *Psychology of Sport & Exercise*, 12(4), 355-367.
- Must A, Tybor DJ. Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth. *International journal of obesity (2005)*. 2005;29 Suppl 2:S84-96.
- Nation-Grainger, S. (2017). "It's Just PE 'till' It Felt Like a Computer Game": Using technology to improve motivation in physical education. *Research Papers in Education*, 32(4), 463-480. doi:http://dx.doi.org/10.1080/02671522.2017.1319590
- Oluwasanu, M. & Oladepo, O. (2017). Effects of a multi-level intervention on the pattern of physical activity among in-school adolescents in Oyo state Nigeria: A cluster randomized trial. *BMC Public Health* 17: 1-11.
- Palmer, K., Robbins, L.B., Ling, J., Kao, T., Voskuil, V.R., & Smith, A.L, (2020). Adolescent autonomous motivation for physical activity: A concept analysis, *Journal of Pediatric Nursing*, ISSN 0882-5963, doi.org/10.1016/j.pedn.2020.04.020.
- Pate, Flynn, & Dowda (2016). Policies for promotion of physical activity and prevention of obesity in adolescence, *Journal of Exercise Science & Fitness*,14,(2), doi.org/10.1016/j.jesf.2016.07.003.
- Perlman, D. (2013). The influence of the social context on students in-class physical activity. *Journal of Teaching in Physical Education*, 32(1), 46-60. doi:http://dx.doi.org/10.1123/jtpe.32.1.46

- Physical Activity Resource Center for Public Health (n.d.). (2020) Retrieved from:
<http://www.parcph.org/accDef.aspx>
- Ratey, J. J., & Hagerman, E. (Collaborator). (2008). *Spark: The revolutionary new science of exercise and the brain*. Little, Brown and Co.
- Reinehr, T. (2018). Long term effect of obesity: Time to act. *Nature Reviews Endocrinology*, 14. doi: 10.1038/nrendo.2017.147
- Rodgers B. (2000). Concept analysis: An evolutionary view. *Concept Development in Nursing: Foundations, Techniques and Applications*, 2nd edn (Rodgers, B.I. & Knafl K.A., eds), iSaunders, Philadelphia, PA, pp. 77-102.
- Saez, L., et al. (2018). Using facilitator–receiver peer dyads matched according to socioeconomic status to promote behavior change in overweight adolescents: A feasibility study. *BMJ Open* 8(6): e019731.
- Sebire, S., Jago, R., Fox, K., Edwards, M., & Thompson, J. (2013). Testing a self-determination theory model of children's physical activity motivation: A cross-sectional study. *International Journal of Behavior Nutrition Physical Activity*, 10, 111. doi:10.1186/1479-5868-10-111
- Stults-Kolehmainen, M. A., & Sinha, R. (2014). The effects of stress on physical activity and exercise. *Sports Medicine*, 44(1), 81-121. doi:10.1007/s40279-013-0090-5
- Umstattd Meyer MR, Perry CK, Sumrall JC, Patterson MS, Walsh SM, Clendennen SC, et al. Physical activity–related policy and environmental strategies to prevent obesity in rural communities: A systematic review of the literature, 2002–2013. *Prevention of Chronic Diseases* 2016;13:150406. DOI: <http://dx.doi.org/10.5888/pcd13.150406>

APPENDIX A: Parent/Guardian Consent Form and Adolescent Assent

Title of Project: “Teen Leisure Time Physical Activity (PA) Club” (TLC) for Rural, High School Students Club”

Name of Principal Investigator: Lorraine Robbins

Purpose of the Club: Your adolescent and you are being asked to participate in a research study about physical activity.

The study will test the feasibility of and obtain preliminary evidence of efficacy for a 10-week

TLC PA Club. Description of Project and Length of Participation: A 10-week physical activity club that involves HS students and will be offered at or near your or your teenager’s school or another similar school and through an online public app.

For this club, we are interested in:

9th -12th grade students who are interested in participating in physical activity on a daily basis.

9th – 12th grade students who are able to attend two 75-minute per session after-school club (introductory and closing session).

At this time, we expect the club to occur after school during the week. Community bus transportation will be provided to you or your teenager after the club if it is needed. HS students will be randomly selected for participating in this club based on the club needs. From this club, the researchers expect to learn whether this approach works to improve the health outcomes of HS students.

The following parent/guardian consent/adolescent assent and adolescent screening tool forms MUST be completed to be selected to participate in the program.

IF you or your teen is selected for this club, HE/SHE/YOU will be asked to:

- Answer questions about his/her/your physical activity at Time 1 (before club begins) and Time 2 (after the club ends).
- Have his/her/your height, and weight measured (takes 10 minutes at Times 1 and 2) and percent body fat (takes 10 minutes at Times 1 and 2). Students will be given the option to self-report this if they prefer.
- Wear a small activity monitor that records his/her/your physical activity for 7 days (7 days at Times 1 and 7 days at Time 2). He/she/you will receive daily reminders to wear the monitor by phone or text message.
- IF his/her/your school is selected for this club, participate in the two after-school events (introductory and closing event), receive daily avatar motivational messages, and weekly PA goal and strategy messages.

After testing is complete at Time 1, you/your teen will be notified whether your adolescent's school will receive the physical activity club or not.

School A: Will receive an after-school physical activity club with two face-to-face events (introductory event and closing event after-school) focusing on physical activity and avatar motivational messages and weekly PA and goal strategy messages. The two events will be taught by trained project staff.

School B: Will NOT receive the after-school physical activity club, but HS students will receive some compensation (gifts) for answering survey questions; having their height, weight, and percent body fat measured; and wearing the activity monitor (see below for compensation).

Compensation to all participants: You/Your teenager will receive items for your/his or her time completing tasks:

\$20 cash for properly wearing the activity monitor at Times 1 and 2 (\$40 total)

\$20 cash for answering Qualtrics surveys (online) at Times 1 and 2 (\$40 total) OPTIONAL (School A): Teenagers will randomly be selected to receive \$20 cash for participating in an individual interview at Time 2.

Please note, to participate in the interview, parent/guardian AND teen must give consent and assent to have the teen's discussion audio taped during the interview. See below. Costs to Participants: This club is free for all participants.

Expected Benefits: Your teenager/you will learn about the health testing. They/you may have an opportunity to participate in an after-school physical activity club at their school. Information from this club may be used to develop physical activity clubs for teenagers throughout Michigan.

Possible Risks and Discomforts: For safety reasons, we are interested only in teenagers with no mental or physical health conditions preventing physical exercise. Each teenager will be assisted on an individual basis to slowly increase the intensity of physical activity (at his/her/your own pace) and will receive positive support from the instructors. Risks related to participation among HS students is minimal. We expect the risk to be similar to what teenagers/you might face in a gym class or sports program. It is possible that teenagers/you may feel some mental or emotional stress while answering survey questions about things like their health behaviors. It is possible that participation in a physical activity club could increase unhealthy weight control practices. Any sign of unhealthy practice (i.e., eating disorders) will be referred to the school guidance counselor or other appropriate health professionals. Another risk is breach of confidentiality. As described below, we have extensive plans to keep participants information private. You must sign the waiver to participate in the club. If your teenager/you is injured as a result of participation in this project, MSU will assist in obtaining emergency care, if necessary, for

project-related injuries. If you/your teen have insurance for medical care, your insurance carrier will be billed in the ordinary manner. As with any medical insurance, any costs that are not covered or are in excess of what are paid by your insurance, including deductibles, will be your responsibility. The University's policy is not to provide financial compensation for disability, pain, or discomfort, unless required by law to do so. This does not mean you/your teen are giving up any legal rights you/your teen may have.

Protection from Risk: For you/your teenager's protection, they will be supervised by club staff. At least 1 club instructor will be present at the club each time and will be trained in first aid and CPR. In the unlikely event that a medical emergency occurs, routine emergency procedures will be followed, and parents/guardians will be contacted immediately.

Conflicts of Interest: No person associated with this club has any financial interest or other opportunity for personal benefit related to the conduct of this club. **Keeping Information Private:** Only group information from this club will be reported in presentations or publications. You and your teen will not be identified individually in any reports. Club records will be labeled with codes rather than names. The key to the codes will be kept separately. Only project staff and MSU's Human Research Protection Program (HRPP) will have access to the data. All data will be kept in locked rooms. MSU policy states that data will be stored for a minimum of 3 years from the end of the club. You/your teen's privacy will be protected to the maximum extent allowable by law. Information that identifies your teen/you might be removed from the data collected from ActiGraphs, body composition, or responses to surveys. After such removal, the data collected from ActiGraphs, body composition, or responses to surveys could be used for future research studies or distributed to another investigator for future research studies without additional informed consent from you/your teen. **Voluntary Nature of Participation:** Participation

is voluntary. You/your teenager can stop at any time, without penalty, even after saying “yes” to the club. Refusing to participate will involve no penalty or loss of benefit to which you/your teenager is otherwise entitled. Deciding to stop participating after saying “yes” will not affect future relations with school staff, grades, or the services that you/your teenager receives.

Questions: if you have questions or concerns about you/your teenager’s role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this club, you/your teen may contact, anonymously if you wish, MSU’s Human Research Protection Program at (517) 355-2880; Fax: (517) 432-4503; email: irb@msu.edu; address: 4000 Collins Road, Ste 136, Lansing, MI 48910. If you have any concerns or questions about this club, such as scientific issues, how to do any part of it, or to report any injury, please contact the researcher, Karla Palmer, at MSU College of Nursing, (517-353-3011); email kurnczka@msu.edu at any time. Please complete the following pages and screening tool.

You/your teen may keep the second packet marked “YOUR COPY TO KEEP” for your records.

You/your teen will be notified within 72 hours if you/your teenager has qualified for the club.

Please have your teenager complete the entire packet and bring to our project staff at their high school: (if completing through Qualtrics, responses will be recorded) (printed stickers with location and time to return packets will be placed here).

I have read the information in this form regarding the “Teen Leisure Time Physical Activity Club”. Ms. Karla Palmer is willing to answer any questions that I have about the club. My teen/you will be asked questions about their physical exercise. My teen/you will complete health testing and wear a small activity monitor for 7 days at the beginning and end of the club, and my teen/you will receive avatar motivational messages via their smart device. My teen/you may participate in two after-school events, daily motivation text messages, and weekly PA goals and

strategy messages for 10 weeks if the club is assigned to his/her/your school. I allow my teen to participate in this club.

APPENDIX B: Parent/Guardian Survey

1. What is your age? _____(years old)

2. What is your gender?

A) Male

B) Female

3. What is your ethnicity?

A) Hispanic

B) Non-Hispanic

4. What is your race (select all that apply)?

A) White or Caucasian

B) Black or African American

C) Asian/Pacific Islander

D) American Indian or Alaskan Native

E) Other

5. What is your marital (marriage) status?

A) Married or partnered

B) Separated, divorced, or widowed

C) Single

6. How much was your total annual family income last year?

A) Under \$19,999

B) \$20,000-\$29,999

C) \$30,000-\$49,999

D) \$50,000 or above

7. What is your employment status?

A) Full Time

B) Part Time

C) Unemployed

8. What is your educational level?

A) less than high school graduate

B) High school graduate

C) Some college (at least one year or specialized training)

D) Technical school or community college degree

E) Bachelor's degree

F) Graduate or professional degree

Your Adolescent/Teenage Child

9. What is your child's age? _____ (years old)

10. What is your child's gender?

A) Male

B) Female

11. What is your child's grade?

A) 9th grade

B) 10th grade

C) 11th grade

D) 12th grade

12. Is your child enrolled in the free or reduced-price school lunch program?

A) yes

B) no

13. What is your child's ethnicity?

A) Hispanic

B) Non-Hispanic

14. What is your child's race (select all that apply)?

A) White or Caucasian

B) Black or African American

C) Asian/Pacific Islander

D) American Indian or Alaskan Native

E) Other

**APPENDIX C: Personal Factors and Behavior Survey: Screening Tool for Adolescent
Participants**

The questions below will ask you to tell us some things about yourself. Please select (circle) your answer.

1. How old are you?

A) 14

B) 15

C) 16

2. When were you born? Month_____ Day_____ Year_____

3. What grade are you in? A) 9th grade B) 10th grade

4. Are you Hispanic, Latino, Mexican or Spanish? Yes No

5. What is your race (how do you usually describe or think of yourself)? If MORE THAN ONE race, SELECT ALL THAT APPLY.

A) Asian

B) Native Hawaiian or Pacific Islander

C) Black or African American

D) American Indian, Alaskan Native, or Native American

E) White or Caucasian

F) Other Racial Group_____

6. Right now, how many days per week do you go to gym class?

A) 0 days

B) 1 day

C) 2 days

D) 3 days

E) 4 days

F) 5 days

7. During the past year, were you on a sports or cheerleading team (including any team at your school or outside of your school, such as those run by community groups or other organizations)?

A) Yes

B) No

8. Right now, are you on a sports or cheerleading team (including any team at your school or outside of your school, such as those run by a community groups or other organizations)?

A) Yes

B) No

9. During the past year, were you in any physically active programs at your school or outside of your school, such as those run by community groups or other organizations (NOT including sports or cheerleading teams)? Some examples are health/exercise clubs, lessons in activities such as gymnastics, dance, martial arts, or tennis.

A) Yes

B) No

10. Right now, were you in any physically active programs at your school or outside of your school, such as those run by community groups or other organizations (NOT including sports or cheerleading teams)? Some examples are health/exercise clubs, lessons in activities such as gymnastics, dance, martial arts, or tennis.

A) Yes

B) No

11. On a usual school day, how many hours do you watch TV/movies or play video games on your TV that do NOT involve physical activity? (ONE answer only)

A) I do not watch TV/movies, or play video games on a usual school day

B) 1 hour or less per day

C) 2 hours per day

D) 3 hours per day

E) 4 hours per day

F) 5 hours per day

12. On a usual weekend day (Saturday-Sunday), how many hours do you watch TV/movies or play video games on your TV that do NOT involve physical activity? (ONE answer only)

A) I do not watch TV/movies, or play video games on a usual weekend day

B) 1 hour or less per day

C) 2 hours per day

D) 3 hours per day

E) 4 hours per day

F) 5 hours per day

13. On a usual school day, how many hours do you sit in front of a screen and use it for something that is NOT schoolwork (Internet, social media, games or messaging)? (ONE answer only)

A) I do not use the screen for something that is not schoolwork on a usual school day

B) 1 hour or less per day

C) 2 hours per day

D) 3 hours per day

E) 4 hours per day

F) 5 hours per day

14. On a usual weekend day (Saturday-Sunday), how many hours do you sit in front of a screen and use it for something that is NOT schoolwork (Internet, social media, games or messaging)?
(ONE answer only)

A) I do not use the screen for something that is not schoolwork on a usual school day

B) 1 hour or less per day

C) 2 hours per day

D) 3 hours per day

E) 4 hours per day

F) 5 hours per day

15. On a usual school day, how many hours do you spend sitting/resting and using your phone to talk to people, send text messages, OR play games? (One answer only)

A) I do not talk on the phone or text message on a usual school day

B) 1 hour or less per day

C) 2 hours per day

D) 3 hours per day

E) 4 hours per day

F) 5 hours per day

16. On a usual weekend day (Saturday-Sunday), how many hours do you spend sitting/resting and using your phone to talk to people, send text messages, OR play games? (One answer only)

A) I do not talk on the phone or text message on a usual weekend day

- B) 1 hour or less per day
- C) 2 hours per day
- D) 3 hours per day
- E) 4 hours per day
- F) 5 hours per day

We will include pictures of adolescence doing moderate (Fast walking) to vigorous (running) physical activity.

Moderate (medium) physical activity causes light sweating or a slight increase in breathing or heart rate. An example is fast walking

Vigorous (hard) physical activity causes heavy sweating or large increases in breathing or heart rate. An example is running.

Physical activity can be done in sports, when taking lessons, or while playing with friends.

Some examples of moderate to vigorous physical activity are: biking, cheerleading, swimming, playing tennis, dancing, rollerblading, skateboarding, gymnastics, martial arts (such as karate), soccer, and basketball.

17. In a usual week, how many days do you do moderate to hard physical activity for a total of 1 hour or more per day? (Do NOT count rest breaks)

- A) 0 days per week
- B) 1 day per week
- C) 2 days per week
- D) 3 days per week
- E) 4 days per week
- F) 5 days per week

G) 6 days per week

H) 7 days per week

18. During the past week, how many days did you do moderate to hard physical activity for a total of 1 hour or more per day? (Do NOT count rest breaks)

A) 0 days per week

B) 1 day per week

C) 2 days per week

D) 3 days per week

E) 4 days per week

F) 5 days per week

G) 6 days per week

H) 7 days per week

APPENDIX D: Perceived Autonomy Support in Exercise Settings Questionnaire

Rated 1 (strongly disagree) to 7 (strongly agree)

1. I feel that instructors provide me with choices, options, and opportunities about whether to do active sports and/or vigorous exercise in my free time. 1 2 3 4 5 6 7
2. I think that my instructors understand why I choose to do active sports and/or vigorous exercise in my free time. 1 2 3 4 5 6 7
3. My instructors displays confidence in my ability to do active sports and/or vigorous exercise in my free time. 1 2 3 4 5 6 7
4. My instructors encourages me to do active sports and/or vigorous exercise in my free time.
1 2 3 4 5 6 7
5. My instructors listens to me about my active sports and/or vigorous exercise in my free time. 1
2 3 4 5 6 7
6. My instructors provides me with positive feedback when I do active sports and/or vigorous exercise in my free time. 1 2 3 4 5 6 7
7. I am able to talk to my instructors about the active sports and/or vigorous exercise I do in my free time. 1 2 3 4 5 6 7
8. My instructors makes sure I understand why I need to do active sports and/or vigorous exercise in my free time. 1 2 3 4 5 6 7
9. My instructors answers my questions about doing active sports and/or vigorous exercise in my free time. 1 2 3 4 5 6 7
10. My instructors care about the active sports and/or vigorous exercise I do in my free time. 1
2 3 4 5 6 7

11. I feel I am able to share my experiences of active sports and/or vigorous exercise with my instructors. 1 2 3 4 5 6 7

12. I trust my instructors' advice about the active sports and/or vigorous exercise I do in my free time. 1 2 3 4 5 6 7

APPENDIX E: Behavior Regulation in Exercise Questionnaire - 3 (BREQ-3)

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples' decisions to engage or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		Sometimes true for me		Very true for me
1	It's important to me to exercise regularly	0	1	2	3	4
2	I don't see why I should have to exercise	0	1	2	3	4
3	I exercise because it's fun	0	1	2	3	4
4	I feel guilty when I don't exercise	0	1	2	3	4
5	I exercise because it is consistent with my life goals	0	1	2	3	4
6	I exercise because other people say I should	0	1	2	3	4
7	I value the benefits of exercise	0	1	2	3	4
8	I can't see why I should bother exercising	0	1	2	3	4
9	I enjoy my exercise sessions	0	1	2	3	4
10	I feel ashamed when I miss an exercise session	0	1	2	3	4
11	I consider exercise part of my identity	0	1	2	3	4

12	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
13	I think it is important to make the effort to exercise regularly	0	1	2	3	4
14	I don't see the point in exercising	0	1	2	3	4
15	I find exercise a pleasurable activity	0	1	2	3	4
16	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
17	I consider exercise a fundamental part of who I am	0	1	2	3	4
18	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
19	I get restless if I don't exercise regularly	0	1	2	3	4
20	I think exercising is a waste of time	0	1	2	3	4
21	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
22	I would feel bad about myself if I was not making time to exercise	0	1	2	3	4
23	I consider exercise consistent with my values	0	1	2	3	4
24	I feel under pressure from my friends/family to exercise	0	1	2	3	4

APPENDIX F: Basic Psychological Needs in Exercise Score (bPNES)

Instructions. The following sentences refer to your overall experiences in exercise as opposed to any particular situation. Using the 1-5 scale below, please indicate the extent to which you agree with these statements by circling one number for each statement. I don't agree at all (1), I agree a little bit (2), I somewhat agree (3), I agree a lot (4), I completely agree (5).

1. I feel I have made a lot of progress in relation to the goal I want to achieve. 1 2 3 4 5
2. The way I exercise is in agreement with my choices and interests. 1 2 3 4 5
3. I feel I perform successfully in the activities of my exercise program 1 2 3 4 5
4. My relationships with the people I exercise with are very friendly 1 2 3 4 5
5. I feel that the way I exercise is the way I want to 1 2 3 4 5
6. I feel exercise is an activity which I do very well 1 2 3 4 5
7. I feel I have excellent communication with the people I exercise with 1 2 3 4 5
8. I feel that the way I exercise is a true expression of who I am 1 2 3 4 5
9. I am able to meet the requirements of my exercise program 1 2 3 4 5
10. My relationships with the people I exercise with are close 1 2 3 4 5
11. I feel that I have the opportunity to make choices with regard to the way I exercise 1 2 3 4

Key: Autonomy: items 2,5,8,11; Competence: items 1, 3, 6, 9; Relatedness: items 4, 7, 10.

APPENDIX G: TLC Intervention Evaluation Instrument

Did you go to any TLC Club sessions?

If your answer is NO, you are done. If your answer is YES, please answer these questions below.

After-school TLC Club	1 Disagree a lot	2 Disagree a little	3 Agree a little	4 Agree a lot
1. I liked the activities we did in TLC.	☐	☐	☐	☐
2. I liked the TLC instructors.	☐	☐	☐	☐
3. The instructors gave me some choice in selecting the physical activities in the club.	☐	☐	☐	☐
4. TLC was fun.	☐	☐	☐	☐
5. TLC helped me increase my moderate to vigorous physical activity.	☐	☐	☐	☐
6. TLC instructors helped me see a lot of reasons for doing physical activity.	☐	☐	☐	☐
7. TLC instructors helped me rise above problems that stop me from exercising, being active or doing sports.	☐	☐	☐	☐
8. TLC instructors helped me increase my confidence for doing physical activity.	☐	☐	☐	☐
9. TLC instructors motivated me to increase my moderate to vigorous activity outside the TLC sessions.	☐	☐	☐	☐
10. TLC instructors motivated me to get regular moderate to vigorous physical activity outside the TLC sessions.	☐	☐	☐	☐
11. I felt connected to the others who participated and the instructors in TLC (like I belonged in the group).	☐	☐	☐	☐
12. TLC helped me increase my skills for doing physical activity or sports.	☐	☐	☐	☐
13. I felt that the instructors understood why I choose to exercise.	☐	☐	☐	☐
14. I felt the instructors encouraged me to do the exercise activities I wanted to do.	☐	☐	☐	☐
15. I felt that the instructors listened to me about how I would like to take part in exercise activities.	☐	☐	☐	☐
16. They showed confidence in my exercise ability.	☐	☐	☐	☐
17. They helped me improve my exercise ability.	☐	☐	☐	☐
18. They helped me to feel that I am able to do challenging exercise activities.	☐	☐	☐	☐
19. I felt that they cared about me.	☐	☐	☐	☐
20. I felt accepted by the instructors.	☐	☐	☐	☐

APPENDIX H: TLC Peer Delivered Avatar Messages Evaluation

1. How satisfied were you with the avatar messages in general?

- A) Not at all satisfied
- B) Not very satisfied
- C) Somewhat satisfied
- D) Very satisfied

2. I will use the information that I learned from the avatar messages in the future.

- A) Disagree a lot
- B) Disagree a little
- C) Agree a little
- D) Agree a lot

3. Would you recommend the avatar messages to other peers you know?

- A) Yes
- B) No

If “No”, please tell us why.

4. What is the biggest barrier that stopped you from using the avatar messages daily? If you used the messages, please say “none”.

5. What else should be added to the TLC avatar messages to help you be more physical activity?

How can we make it better in the future?

APPENDIX I: TLC Mascot Delivered Weekly PA Goal and Strategies Messages

Evaluation

1. How satisfied were you with the PA Goal and Strategy Messages in general?

- A) Not at all satisfied
- B) Not very satisfied
- C) Somewhat satisfied
- D) Very satisfied

2. I will use the information that I learned from the PA Goal and Strategy Messages in the future.

- A) Disagree a lot
- B) Disagree a little
- C) Agree a little
- D) Agree a lot

3. Would you recommend the PA Goal and Strategy Messages to other peers you know?

- A) Yes
- B) No

If “No”, please tell us why.

4. What is the biggest barrier that stopped you from using the PA Goal and Strategy Messages weekly? If you used the messages, please say “none”.

5. What else should be added to the TLC PA Goal and Strategy Messages to help you be more physical activity? How can we make it better in the future?
