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The Minne-Loppet Motivation Study: An Intervention to Increase Motivation for Outdoor Winter Physical Activity in Ethnically and Racially Diverse Elementary Schools

Jonathan M. Miller, PhD¹, Julian Wolfson, PhD², Melissa N. Laska, PhD³, Toben F. Nelson, PhD³, and Mark A. Pereira, PhD³

¹Division of Family Medicine and Community Health, University of Minnesota, Minneapolis, MN, USA

²Division of Biostatistics, University of Minnesota, Minneapolis, MN, USA

³Division of Epidemiology and Community Health, University of Minnesota, Minneapolis, MN, USA

Abstract

Purpose: To test the effectiveness of an intervention to increase motivation for physical activity in racially diverse third- through fifth-grade students.

Design: Natural experiment.

Setting: Elementary schools in Minneapolis, Minnesota.

Participants: Two hundred ninety-one students in 18 Minne-Loppet Ski Program classes and 210 students in 12 control classrooms from the same schools.

Intervention: The Minne-Loppet Ski Program, an 8-week curriculum in elementary schools that teaches healthy physical activity behaviors through cross-country skiing.

Measures: Pretest and posttest surveys measured self-determination theory outcomes: intrinsic exercise motivation, intrinsic ski motivation, autonomy, competence, and relatedness.

Analysis: Hierarchical linear regression models tested treatment effects controlled for grade, race, sex, and baseline measures of the outcomes.

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Corresponding Author: Jonathan M. Miller, PhD, Division of Family Medicine and Community Health, University of Minnesota, 717 Delaware Street Suite 166, Minneapolis, MN 55414, USA., mill5687@umn.edu.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Jonathan Miller was employed as a coach by the Loppet Foundation during data collection for this study.

Authors' Note

The Minne-Loppet Curriculum was originally written by Margaret Adelsman, PhD, Linda Armstrong, RD, Mark Bixby, MD, and John Munger. The Curriculum was updated by Jonathan M. Miller and Allie Rykken.

Supplemental Material

Supplementary material for this article is available online.

Results: Minne-Loppet program students showed significantly greater motivation to ski ($\beta = 0.95$, 95% confidence interval [CI]: 0.15–1.75) and significantly greater perceived competence ($\beta = 0.78$, 95% CI: 0.06–1.50) than students in control classrooms. Treatment effects for general exercise motivation and perceived competence differed by race. African American students in Minne-Loppet classes showed significantly greater general exercise motivation ($\beta = 1.08$, 95% CI: 0.03–2.14) and perceived competence ($\beta = 1.95$, 95% CI: 0.91–2.99) than African American students in control classes.

Conclusion: The Minne-Loppet program promoted perceived competence and motivation to ski. Future improvements to the Minne-Loppet and similar interventions should aim to build general motivation and provide support needed to better engage all participants.

Keywords

fitness; interventions; young children; age-specific; specific populations; racial minority groups; underserved populations; school; specific settings; low income

Purpose

Physical inactivity is epidemic. Objective measures indicate that only 40% of children under 12 years in the United States meet weekly recommended levels of moderate-to-vigorous physical activity; by adolescence, this proportion drops below 10%.¹ Lack of physical activity is a direct cause of obesity and is associated with other chronic diseases including heart disease, diabetes, and some cancers.^{2,3} Developing strategies to increase population levels of physical activity is a pressing public health concern.

Physical activity interventions among children have generally shown small effects on longer term outcomes such as weight status or leisure time physical activity.⁴ Recent physical activity trials, particularly in the United Kingdom and Australia, have been organized around self-determination theory,^{5–7} with the advantage that the theory proposes intermediate markers of behavior change that can be measured and expected to show differences in shorter time scales. Self-determination theory⁸ proposes that autonomous or intrinsic motivation develops if a student's needs for autonomy, perceived competence, and feelings of relatedness to teachers and other students are met. However, we are unaware of any self-determination theory–based trials occurring in schools in the United States.

Physical education presents an opportunity to promote physical activity, especially in school districts where physical education classes are required. Physical education may promote sustainable increases in population physical activity over the life course if it promotes the development of intrinsic or autonomous motivation to exercise or be physically active. The trans-contextual model,⁹ a corollary to self-determination theory, proposes that intrinsic motivation in one context such as physical education may translate into intrinsic motivation for similar activities in a different context such as exercising outside of school time (Figure 1). Previous studies^{10–12} have shown that motivation, measured through a lens of self-determination theory, predicts leisure time physical activity in adolescents^{10,12} and adults.^{11,13–15} These studies indicate that intrinsic motivation can predict physical activity behavior as much as 1 to 3 years later.^{14,15}

In addition to organizing around behavior theories and considering intermediate markers of behavior change, interventions may also need to consider the difference in intervention effects between relevant population subgroups to further increase effectiveness at improving population levels of physical activity. While physical activity studies have increasingly sought diverse samples, we are aware of relatively few that have undertaken subgroup analysis within these samples. With respect to race/ethnicity and sex, we are aware of only 2 trials^{16,17} in which investigators considered effects within subgroups of both sexes and of more than 1 race/ethnicity within the same sample. Therefore, the present study aims to evaluate a winter physical activity intervention grounded in self-determination theory and to consider whether the intervention effects differ between the sexes or between ethnicities/races.

In the present study, we examine self-determination theory outcomes from the Minne-Loppet Ski Program, in the Twin Cities of Minnesota. The Twin Cities was rated by the American College of Sports Medicine as the fittest city in the United States in 2017 based on community programs and policies to support physical activity.¹⁸ Programs such as the Minne-Loppet Ski Program were designed to embrace cold winters in Minnesota and counteract the tendency for youths to get less physical activity during cold months.¹⁹

Our a priori hypotheses were that students in the Minne-Loppet program would show greater increases in reported feelings of autonomy, competence, and relatedness in physical education classes as well as greater increases in reported intrinsic motivation to ski and intrinsic motivation to exercise generally as compared to students in control classrooms. We also hypothesized that the effects of the Minne-Loppet program on self-determination theory outcomes will differ by sex and by ethnicity/race.

Methods

Intervention

The Minne-Loppet Ski Program is a partnership between public schools in the Twin Cities Metropolitan Area of Minnesota and the Loppet Foundation to teach healthy physical activity and nutrition behaviors through cross-country skiing. The Loppet Foundation provides ski equipment to the schools and coaches who teach an 8-week curriculum during the school day to third-through fifth-grade students at several Twin Cities schools from November to February each winter. In 2015 to 2016, 679 students from 8 schools participated in the Minne-Loppet Ski Program.

The Minne-Loppet curriculum was originally developed in 2008 to include 8 lessons. Each 50-minute lesson in the Minne-Loppet curriculum includes a ski skill, a nutrition game, and time for free skiing. In 2014, the curriculum was substantially revised and updated to fit within a self-determination theory⁸ framework: to build motivation to exercise and to ski by supporting students' needs to feel autonomous, competent, and relatedness. The 2014 curriculum updates emphasize allowing time for free skiing to support autonomy. The 2014 curriculum update also changed the sedentary nutrition lesson component of the original curriculum to active nutrition games, such as carbohydrate freeze tag, a game played on skis that teaches the difference between simple sugars and complex carbohydrates. The goal of

changing to active nutrition games was to support development of competence by maximizing the students' time on skis and to support relatedness by providing team-based activities.

At the end of the 8-week curriculum, the students are invited to participate in the Minne-Loppet Event. The Minne-Loppet Event is a 1- or 2-km ski race held in Minneapolis as part of the City of Lakes Loppet Ski Festival: a weekend festival of cross-country ski races and related winter sports that attracts over 10 000 participants each year. The Loppet Foundation provides transportation and equipment for all participating students.

Design

The Minne-Loppet Motivation Study was a natural experiment conducted during the 2015 to 2016 school year in 5 of the 8 elementary schools participating in the Minne-Loppet Ski Program. The Minneapolis Public Schools Research, Evaluation and Assessment Department approved the study for the 7 participating Minneapolis Public Schools. One school declined to participate and 1 school could not be assessed at baseline due to scheduling difficulties.

Sample

The Minne-Loppet Motivation Study included a 34-item presurvey and an identical postsurvey of 321 students in 18 treatment classrooms and 219 students in 12 control classrooms. The decision about which classes received the Minne-Loppet Ski Program was made by teachers at each school in coordination with Loppet coaches and was primarily determined by schedule availability. Therefore, it was not possible to randomly assign classes to treatment or intervention. The control classrooms were surveyed from the same schools as the treatment classrooms except in 1 school where all students received the Minne-Loppet Program. Students in control classrooms received normal physical education.

Surveys were administered by trained study staff during the first 2 weeks of the Minne-Loppet Ski Program (presurveys) and during the 2 weeks following the Minne-Loppet Event (postsurveys). Classrooms were assigned to be controls or to receive the Minne-Loppet Ski Program before the surveys were given and students were aware of these assignments. All surveys were administered in either classrooms or in a gymnasium during physical education class. Students were instructed that the survey was not a test and that they should not share answers. To improve comprehension, study staff read the questions aloud during each survey administration. Passive consent was obtained from parents of all participants and active assent was obtained from all participants. All study procedures were approved by the institutional review board at the University of Minnesota and by the Research, Evaluation and Assessment Department at Minneapolis Public Schools.

Of the 540 students surveyed at baseline, 501 completed surveys at follow-up, representing a 93% retention rate. The final analysis sample was, therefore, 291 students in Minne-Loppet classrooms and 210 students in control classrooms. Both χ^2 tests and t tests comparing those who remained to those who lost to follow-up showed that students lost to follow-up were more likely to be African American than students who were retained (58.8% compared to 37.8%, $P = .045$), were more likely to be from Minne-Loppet class-rooms than control

classrooms (76.9% of those lost to follow-up were in Minne-Loppet classrooms compared to 58.1% of those retained, $P = .02$), and reported 1.2 fewer years at their current school than students who were retained ($P = .0004$).

The differential missingness between the treatment groups created the possibility of selection bias in analysis. To account for this, all models were weighted using inverse probability weights. Inverse probability weights were created to represent the probability of being surveyed at follow-up as a function of race, sex, year in school, treatment group, years attending their current school, and baseline measures of physical education autonomy, competence, relatedness, intrinsic motivation to exercise, and intrinsic ski motivation.

Measures

Survey variables were adapted from the instrument to measure physical education self-determination used by Standage et al.²⁰ The survey was piloted in Minne-Loppet Ski Program classes during the 2014 to 2015 school year. Cronbach α for the 2014 to 2015 piloting ranged from .57 for the autonomy scale to .89 for the ski motivation scale. Based on reliability results from the 2014 to 2015 piloting, items on the survey were updated to improve understanding of the questions among third through fifth graders. All items were measured on a 5-point Likert scale anchored by “disagree” and “agree.”

Exercise motivation.—The exercise motivation score was the sum of 4 items beginning with the stem, “I exercise because...” An example item from the exercise motivation scale is, “I exercise because I enjoy learning new skills.” This score ranged from 4 to 20 and showed adequate internal validity (Cronbach $\alpha = .78$ at presurvey and .82 at postsurvey).

Ski motivation.—The ski motivation score was the sum of 4 items identical to the exercise motivation items but beginning with the stem “I ski because...” An example item from the ski motivation scale is, “I ski because it is exciting.” This score ranged from 4 to 20 and showed good internal validity (Cronbach $\alpha = .86$ at presurvey and .88 at postsurvey).

Autonomy.—The autonomy score was the sum of 6 items that assess freedom of choice during physical education class.²⁰ An example item from the autonomy scale is “During PE class I have some choice in what I want to do.” One item in the autonomy score was reverse coded. This score ranged from 6 to 30 (Cronbach $\alpha = .60$ at presurvey and 0.54 at postsurvey).

Competence.—The competence score was the sum of 5 items that assess perceived competence during physical education class.²⁰ An example item from the competence scale is “I am satisfied with my performance in the PE class.” One item in the competence score was reverse coded. This score ranged from 5 to 25 and showed fair internal validity (Cronbach $\alpha = .66$ at presurvey and .67 at postsurvey).

Relatedness.—The relatedness score was the sum of 5 items that assess relationships with other students in physical education class. An example item from the relatedness scale is “I feel valued by the other students in this PE class.” This score ranged from 5 to 25 and showed adequate internal validity (Cronbach $\alpha = .79$ at presurvey and .81 at postsurvey).

Demographics.—Gender was self-reported by students as boy or girl. Race/ethnicity was self-reported as identifying as 1 or more of black or African American, Hispanic or Latino, Asian American, American Indian or Native American, or white. Respondents who identified as Hispanic or Latino were classified as Hispanic regardless of whether they identified as any additional races. Respondents who identified as 2 or more non-Hispanic races were classified as mixed. Due to small sample sizes, respondents who identified as Asian American were collapsed into the mixed/other class. Students self-reported their year in school and this was checked against class lists by the investigator for accuracy. Students also were asked, “How many years have you gone to this school?”

Analysis

The Minne-Loppet arm and the control arm were compared on baseline demographic variables with χ^2 tests and on baseline levels of the self-determination theory scores using crude random intercept models of treatment status on each score with a random effect for classroom. To assess clustering at the classroom and at the school levels, 2 unconditional random intercept (intercept only) models were run for each outcome. The first unconditional random intercept model included a random effect for classroom; the second unconditional random intercept model included random effects for school and for classroom nested within school. Intraclass correlation coefficients (ICCs) were calculated from the variance components of these unconditional random intercept models.

Random intercept models were used to test the treatment effects on the self-determination theory scores. One model was run for each of the 5 self-determination theory outcomes. Each model was a regression of the self-determination theory outcome on treatment status with a random effect for classroom, which was the unit of treatment assignment. Because classrooms could not be randomly assigned to treatments, all models were adjusted for race, sex, year in school, years attending the current school, and the baseline level of the self-determination theory variable. To test for difference in the treatment effect by sex, a 2-way interaction term of treatment with sex was added to each of the models. Separately, to test for difference in the treatment effect by race/ethnicity, a 2-way interaction term of treatment with race/ethnicity was added to each of the models. If interaction terms were statistically significant at $P < .05$, then models stratified on either race/ethnicity or on sex were run. Analyses were conducted with the Statistical Analysis System (SAS, version 9.4, 2013; SAS Institute, Cary, North Carolina).

Results

The Minne-Loppet arm and the control arm were similar on all demographic variables and baseline self-determination theory scores except for year in school, intrinsic ski motivation, and autonomy at baseline. The Minne-Loppet arm showed significantly greater ski motivation ($P = .0009$) and significantly lower autonomy ($P = .03$) at baseline than the control arm (Table 1). The greater ski motivation in the Minne-Loppet arm is expected, given that students were aware of their classroom’s assignment prior to survey administration. The Minne-Loppet arm included fewer third graders (14.0% compared to 37.0%) and more fourth graders (44.6% compared to 25.6%) than the control arm (Table 1: $P_{\text{chisq}} < .0001$). At

presurvey, there were 540 respondents. Of these, 501 also completed the postsurvey (92.8% retention rate).

In unconditional random intercept models with random effects specified for school and for classroom nested within school, the ICC for school ranged from 0.008 for the competence outcome to 0.04 for the autonomy outcome. The ICC for classroom nested within school ranged from 0.03 for the relatedness outcome to 0.08 for the autonomy outcome. In unconditional random intercept modes with random effects specified only for classroom, the ICC for classroom ranged from 0.04 for the competence outcome to 0.12 for the autonomy outcome.

Treatment Effects

The Minne-Loppet arm did not differ significantly from the control arm on exercise motivation, autonomy, or relatedness (Table 2). The Minne-Loppet arm showed significantly greater ski motivation at postsurvey than the control arm ($\beta = 0.94$, 95% confidence interval [CI]: 0.14–1.73), adjusted for race, sex, year in school, years attending their current school, and baseline levels of ski motivation (Table 2). The Minne-Loppet arm also showed significantly greater physical education competence at postsurvey than the control arm ($\beta = 0.76$, 95% CI: 0.04–1.47), adjusted for race, sex, year in school, years attending their current school, and baseline levels of competence (Table 2).

Differences by Race and Sex

There were no differences in treatment effects by sex on any of the self-determination theory outcomes. The treatment effect on exercise motivation (interaction $P = .04$) and on physical education competence (interaction $P = .03$) differed significantly by race/ethnicity. Since interaction terms only identify that a difference exists and not where the difference exists, we explored the differences in treatment effects by race/ethnicity using stratified models. When stratified on race/ethnicity, there was a significant positive treatment effect on competence among African American students ($\beta = 1.95$, 95% CI: 0.91–2.99), but not among white or Hispanic students (Table 3). Similarly, there was a significant positive treatment effect on intrinsic motivation to exercise among African American students ($\beta = 1.08$, 95% CI: 0.03–2.14), but not among Hispanic students (Table 3). Among white students, the treatment effect on intrinsic motivation to exercise did not reach statistical significance, but was similar in magnitude ($\beta = 0.92$, 95% CI: 2.07 to 3.91) to the treatment effect among African American students. The nonsignificance among white students on intrinsic motivation to exercise may be due to lower power considering the small sample size of white students in the population ($n = 61$). While there was not statistical evidence of difference in treatment effects by sex, we have reported all the stratified treatment effects in online supplements (Table A1).

Discussion

This study found that students in the Minne-Loppet Program showed greater changes in physical education competence and ski-specific motivation after the 8-week intervention than students in the control classrooms. While no significant main effect for general exercise

motivation was observed, when the sample was stratified on race, there was a significant effect for general exercise motivation among African American students, but not among Hispanic Students. The effect for general exercise motivation among white students was roughly the same magnitude as for African American students; however, the small sample size of white students limited the statistical power to detect a significant treatment effect. These findings provide evidence that the Minne-Loppet Program may show some effectiveness at increasing ski motivation. Future rounds of the program may benefit from incremental changes that better support other self-determination theory outcomes, particularly autonomy, and from determining which incremental changes may better engage students who are showing less change in motivation over the course of the program.

While previous large multicomponent interventions, such as the Child and Adolescent Trial for Cardiovascular Health²¹ or the Trial of Activity for Adolescent Girls,²² have shown small effects on longer term outcomes, such as body mass index and general moderate-to-vigorous physical activity behavior,^{4,6,7} or required multiple year intervention durations to show an effect,^{21,22} more proximal outcomes like motivation may show change in shorter trials.^{6,7,23} Intervening to change motivation is important, as motivation in one context may increase motivation in other contexts and thereby create sustainable changes in physical activity behavior.⁹ This study showed that the Minne-Loppet Program has had success in supporting the perceived competence as well as intrinsic ski motivation of students in the program. This is encouraging since cross-country skiing is a complex activity that involves dynamic balance in gliding and coordination of both arm and leg movements. However, full support of intrinsic motivation to exercise is most likely to occur if both relatedness and autonomy are supported as well. Particularly, theorists^{9,24} identify autonomy support as first among equals in determining intrinsic motivation and the key element for promoting the transfer of intrinsic motivation in one domain (motivation to ski) to more general domains (motivation to exercise). We have shown that the Minne-Loppet is supporting domain-specific motivation (for skiing) but is not universally supporting general exercise motivation, particularly among Hispanic students. Future research will be needed to improve our understanding of how the constellation of self-determination theory outcomes interact to lead from more specific motivation to more general motivation, and what characteristics of the program can be improved to better engage all students. Further, delineating the successful aspects of the program will allow the characteristics to be applied to and tested in other sports and physical activity interventions.

Suggestions for Program Improvement and Future Research

The curriculum for Minne-Loppet Ski Program is currently in its second version, and this is the first version to be guided by self-determination theory. There is, therefore, room to improve autonomy support. One simple way to improve autonomy support is to offer choices of activities within each lesson. For example, offering a competitive game, such as soccer on skis, as well as a noncompetitive challenge course where students are encouraged to improve on their own performance at their own pace could improve autonomy support by offering choices. Furthermore, this approach would meet the needs of children who are competitively inclined as well as those who are not.

A more complex way to support autonomy may involve working closely with the schools. While none of the classroom ICCs were particularly high, the fact that the autonomy outcome had the highest ICC (0.12) could indicate classroom and school policies have some impact on the students' experience in the Minne-Loppet program. A particular example of a school policy that is of interest is school cold weather policy. If a school is particularly cautious about letting students outside in cold weather—some schools require indoor recess if the temperature is below -9°C —the students may learn that it is not possible to safely be outside in cold weather, which may decrease their feelings of autonomy. Future work might test whether a change in schools' cold weather policies has an impact on students' levels of autonomy.

Future research should also consider the relationship between autonomy competence and relatedness. Do the 3 act synergistically? Is autonomy more predictive of motivation than relatedness and competence? Does 1 of the 3 need to precede the others? For example, is competence support a prerequisite for autonomy support? As skiing is a skill intense sport, the time frame required to develop true competence is likely longer than the follow-up of this study, particularly among children of this age. Future studies, as well as future data collection efforts with the Minne-Loppet program, should collect measures of competence and autonomy at multiple time points on the same individuals and determine whether the trend in competence truly does predict a lagged trend in autonomy.

Finally, future research will be needed to determine which specific aspects of the Minne-Loppet program are responsible for improvements in motivation, whether these aspects can be applied to other sports and physical activity programs and interventions, and whether there are characteristics of the program that could be improved to better support motivation for all students—for example, Hispanic students as identified in this study. Are there particular characteristics of the coaches that make them more or less effective, like their delivery style or if they are of the same ethnicity/race as the students? Would it be useful to have bilingual coaches? Future research and evaluation partnership with the Loppet Foundation will allow us to test such incremental changes by randomly assigning classes to receive these changes during a season and then roll the successful changes out to all participants in following years and will become the basis for an iterative community health intervention partnership model of health behavior interventions. These lessons could be applied also to other sports—particularly since skiing is a winter activity and the lessons learned from one winter may be lost before the next.

Strengths and Limitations

Because scheduling for the Minne-Loppet program is based on availability of the coaches and the classrooms, it was not possible to randomize the classrooms to receiving the Minne-Loppet program. While the assignment to the Minne-Loppet program is generally based on scheduling, it is possible that some teachers use the Minne-Loppet program as a reward for well-behaved classes. Further, since the Minne-Loppet is a popular program, some teachers take other classes skiing outside of the Minne-Loppet program. This introduces the possibility that control classrooms received some level of the Minne-Loppet intervention (contamination). We addressed this limitation to the best of our ability by sampling control

classrooms from the same schools as Minne-Loppet program classrooms and by adjusting all analyses for year in school, race, sex, and baseline measures of all outcome variables to improve the exchangeability of control classrooms and Minne-Loppet program classrooms. Further, we expect that if participants in control classes were allowed to ski during the school year, this would most likely bias effect estimates toward the null.

This study is also limited by the self-report nature of all the measures used. The students are aware of the purpose of the Minne-Loppet program and therefore may be more likely to report increased motivation because of a social desirability bias or demand characteristics.^{25,26} Attempts were made to minimize this by explaining at each survey collection that the students would not be evaluated based on their answers. However, future data collection with the Minne-Loppet program should expand to include measures that are less susceptible to demand characteristics or social desirability—such as direct observation or accelerometer measurement of actual physical activity during the lessons. Also, future Minne-Loppet data collection should shift away from collecting the self-report measures during Minne-Loppet classes and should collect them weeks before the program begins and weeks after the program ends in a more neutral setting like a computer lab. The present study represents the first test of the Minne-Loppet program effect on exercise motivation, and in future studies, we aim to collect longer term follow-ups as well to measure the durability of any effects.

Another limitation is the generalizability of this study. The Minne-Loppet program was evaluated in 1 school district in Minnesota. It is unclear whether the program would be effective in other districts or in other states. Since this is a cross-country skiing intervention, it will not be directly transferable to areas that do not receive snowfall during the winter. However, we have suggested that future studies should identify successful characteristics of the Minne-Loppet program and test whether these characteristics can be applied in other interventions.

A substantial strength of this study was the use of self-determination theory, a theory of motivation development, and the trans-contextual model to inform and evaluate the curriculum. By measuring autonomy, competence, and relatedness as well as motivation for exercise and motivation for skiing, we were able to generate evidence about which needs were being supported. This allowed us to suggest school policy changes and modifications to the curriculum that should be tested to better support intrinsic motivation to exercise.

This study also benefitted from a diverse sample that allowed examination of the effects within subgroups. We are aware of only 2 physical activity intervention trials that examined treatment effects within subgroups of both sexes and more than 1 race.^{16,17} In this study, we were able to show that the effects of the Minne-Loppet program did not differ by sex and that competence and general motivation to exercise seemed to be more supported in African American students and potentially white students than in Hispanic students.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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SO WHAT?**What is already known on this topic?**

Motivation to exercise and the self-determination theory components of motivation predict leisure time physical activity in adolescents and adults as much as 3 years later. Studies are currently underway to increase motivation to exercise during physical education.

What does this article add?

The Minne-Loppet Motivation Study showed a treatment effect on motivation to ski and, in some subgroups, on motivation to exercise. To our knowledge, this is the first study to show treatment effects on motivation for an intervention grounded in self-determination theory and specifically designed to promote winter outdoor physical activity in grade school children.

What are the implications for health promotion practice or research?

This study represents the first effort in what we hope will become a model for community-based public health behavior interventions: with researchers committing to a long-term partnership with a community organization (here, the Loppet Foundation) that can sustainably implement the intervention. The long-term relationship, which we call the iterative community health intervention partnership (ICHIP), will benefit the community organization by providing evaluation of their programs and will benefit behavior researchers by presenting an opportunity to test causal mechanisms by randomizing incremental changes, rather than trying to intervene on everything at once as in previous obesity prevention trials. Efforts are currently ongoing to expand this partnership with the Loppet Foundation as a model for future partnerships based on the areas for future work identified in this study.

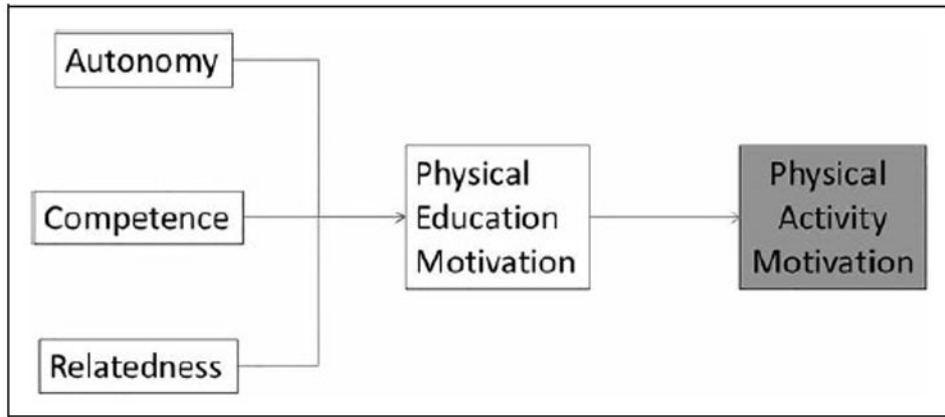


Figure 1. Development of motivation as proposed by self-determination theory and the trans-contextual model.

Table 1.

Demographics and Baseline by Treatment.

	Minne-Loppet	Control
Classrooms, n (%)	18 (60.0%)	12 (40.0%)
Individuals, n (%)	321 (59.4%)	219 (40.6%)
Year in school, n (%) ^a		
3rd	45 (14.0%)	81 (37.0%)
4th	143 (44.6%)	56 (25.6%)
5th	133 (41.4%)	82 (37.4%)
Sex and race/ethnicity, n (%)		
Male	179 (55.9%)	116 (53.2%)
White	22 (12.6%)	20(17.2%)
African American	74 (42.3%)	37 (32.0%)
Hispanic	39 (22.3%)	27 (23.3%)
Mixed or other	40 (22.9%)	32 (27.6%)
Female	141 (44.1%)	102 (46.8%)
White	11 (7.9%)	8 (8.0%)
African American	61 (43.6%)	36 (36.0%)
Hispanic	34 (24.3%)	25 (25.0%)
Mixed or other	34 (24.3%)	31 (31.0%)
Baseline, mean (SD)		
Exercise motivation score	16.8 (3.7)	16.5 (3.5)
Ski motivation score ^a	17.5 (3.5)	16.0 (4.5)
Autonomy score ^a	20.8 (5.1)	22.9 (3.9)
Competence score	20.1 (3.7)	19.9 (4.2)
Relatedness score	19.0 (4.9)	19.2 (4.2)

Abbreviation: SD, standard deviation.

^aMinne-Loppet arm differs significantly from the control arm at $P < .05$.

Table 2.

Treatment Effect Estimates on Each Self-Determination Theory Outcome.

	Treatment Effect, p (95% CI)
Exercise Motivation ^a	0.12 (−0.73 to 0.96)
Ski motivation ^a	0.95 (0.15 to 1.75) ^b
Autonomy ^c	0.18 (−1.01 to 1.36)
Competence ^d	0.78 (0.06 to 1.50) ^b
Relatedness ^c	0.64 (−0.18 to 1.46)

Abbreviation: CI, confidence interval.

^aRange of possible scores for the motivation scales is 4 to 20.^bMinne-Loppet arm differs significantly from the control arm at $P < .05$.^cRange of possible scores for the autonomy scale is 6 to 30.^dRange of possible scores for the competence and relatedness scales is 5 to 25.

Table 3.

Treatment Effect Estimates on Self-Determination Theory Constructs Stratified by Ethnicity/Race.

	African American: Treatment Effect, β (95% CI)	Hispanic: Treatment Effect, β (95% CI)	White: Treatment Effect, β (95% CI)	Mixed or Other: Treatment Effect, β (95% CI)
Exercise motivation ^{a,b}	1.08 (0.03 to 2.14) ^c	-0.02 (-1.76 to 1.72)	0.92 (-2.07 to 3.91)	-1.1 (-2.43 to 0.22)
Ski motivation ^a	1.51 (0.18 to 2.85) ^c	1.48 (0.18 to 2.79) ^c	0.1 (-2.28 to 2.47)	-0.14 (-1.65 to 1.38)
Autonomy ^d	1.01 (-0.46 to 2.47)	-1.17 (-3.47 to 1.14)	-0.39 (-3.08 to 2.3)	0.49 (-1.59 to 2.56)
Competence ^{e,b}	1.95 (0.91 to 2.99) ^c	-0.14 (-1.69 to 1.42)	0.63 (-0.94 to 2.19)	-0.19 (-1.64 to 1.26)
Relatedness ^e	1.21 (-0.27 to 2.69)	0.93 (-0.51 to 2.37)	0.41 (-1.9 to 2.71)	0.08 (-1.69 to 1.84)

Abbreviation: CI, confidence interval.

^aRange of possible scores for the motivation scales is 4 to 20.^bThe interaction term of treatment \times race is significant at $P < .05$.^cMinne-Loppet arm differs significantly from the control arm at $P < .05$.^dRange of possible scores for the autonomy scale is 6 to 30.^eRange of possible scores for the competence and relatedness scales is 5 to 25.