

COMPARATIVE EFFECTIVENESS RESEARCH

Urban Latino Children's Physical Activity Levels and Performance in Interactive Dance Video Games

Effects of Goal Difficulty and Goal Specificity

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Objective: To examine the effects of different levels of goal specificity and difficulty on Latino children's performance and physical activity (PA) levels in an after-school program incorporating an interactive dance program (Dance Dance Revolution [DDR]; Konami Corporation).

Design: Comparison study.

Setting: Rose Park Elementary School, Salt Lake City, Utah.

Participants: Ninety-eight Latino children in the first through sixth grades, aged 7 to 13 years.

Intervention: After the pretest, the participants were randomly assigned into 1 of the following 3 goal-setting conditions: (1) easy, (2) difficult, and (3) best effort (hereinafter referred to as do-your-best goal).

Main Outcome Measures: Participants' PA levels were measured using piezoelectric pedometers, and steps per minute were used as the outcome variable. Participants' total points for their dance on television screens were re-

trieved as their performance scores. These outcome variables were assessed again 8 weeks later (posttest score).

Results: The multivariate analysis of covariance yielded a significant main effect for the goal-setting condition. Follow-up tests revealed that children who set specific (easy or difficult) goals had significantly greater increased PA levels (mean scores, 10.34 for easy and 22.45 for difficult) and DDR performance (0.011 for easy and 0.67 for difficult) than those in the do-your-best group (0.83 for PA and 0.17 for performance). In addition, children's increased PA levels in the difficult-goal group were significantly higher than those in the easy-goal group.

Conclusions: The easy- and difficult-goal groups show a significant improvement on DDR performance. The difficult-goal group also displays the highest improvement on PA levels. Strategies to enhance children's DDR performance and PA levels are discussed in relation to the extant goal-setting literature.

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THE PREVALENCE OF OVER-weight and obesity in children and youth in the United States has increased dramatically, owing in part to physical inactivity during the past decade.^{1,2} As the largest minority population, Latino children and youth are no exception. For instance, the prevalence of overweight and obesity in the Latino population, especially among children and youth, is increasing and is considered a significant health problem.³ According to the Centers for Disease Control and Prevention,⁴ Latino children and youth are experiencing a highly unbalanced burden of multiple health behavior risk factors and suboptimal health status (eg, type 2 diabetes and cardiovascular

disease).⁵ However, only a few studies have been conducted on the effect of physical activity (PA) interventions on physical health and well-being in Latino subjects. Therefore, research is needed to design and implement effective PA programs to facilitate the development and maintenance of a physically active lifestyle among this segment of the population.

In the past decades, goal setting has been widely used as an effective strategy to motivate individuals in many fields, including sports and PA.⁶ In particular, goal setting has been proven to be an effective motivational technique for enhancing individual productivity and performance.^{6,7} According to the mechanistic goal theory of Locke and Latham,⁶ goal setting refers to a process of setting targets

as a means of developing and sustaining effort and persistence, mobilizing energy expenditure, developing self-regulation strategies, and directing appropriate attentional focus. The following 2 major aspects of the mechanistic goal theory focus on the effects of goal specificity and goal difficulty on performance: (1) setting specific goals has superior performance effects compared with setting best-effort goals (hereinafter referred to as do-your-best goal) or no goals; and (2) setting difficult but acceptable goals has superior performance effects compared with easy goals.

Numerous empirical studies have strongly supported the effectiveness of these 2 postulations in the industrial and organizational fields.^{8,9} In sports and PA settings, most research studies have found goal setting to be associated with enhanced performance.^{10,11} A few studies, however, failed to substantiate the effects of goal specificity and difficulty on performance.^{12,13} The inconclusive results have been attributed to several methodological flaws identified by Locke.¹⁴ These limitations included failure to control spontaneous goal setting in do-your-best (control) groups, failure to make specific goals difficult, and failure to control for social comparisons that are inherent in sport.

Given these methodological considerations, it is imperative to heed the suggestions of Locke and Latham⁶ when conducting goal-setting research in PA. One possible way to limit spontaneous goal setting is through consideration of the choice of task relative to those completing it. Specifically, selection of a novel task and/or participants' lack of experience with a task could limit participants' ability to set goals spontaneously.¹⁵⁻¹⁷ In the present investigation, a new program combining music with PA—an interactive dance program (Dance Dance Revolution [DDR]; Konami Corporation)—was integrated into an after-school program. The DDR program involves interactive floor pads and a big-screen video monitor, in which students stand on the pads and follow the dance instructions step by step.^{18,19} The DDR program also allowed the researchers to control and monitor goal difficulty through the establishment of specific goals, thus overcoming limitations associated with failure to make specific goals difficult.¹⁰ In addition, social comparison effects among children were controlled through the rigid study design in this study.

An omission with the application of goal-setting theory in PA is the lack of empirical data among Latino children. Using DDR as a new curricular activity, our study aimed to address this shortcoming. Further, previous studies with methodological problems have yielded somewhat equivocal results. This study was designed to investigate the effects of goal specificity and difficulty on children's PA and performance with a research design that considered the methodological concerns raised by Locke et al.¹⁴ Investigating the links between goal setting and PA/performance is important for health care professionals to fully understand issues associated with motivating strategies and PA/performance in achievement settings and to implement ideal motivating techniques for youth.

This study examined the effects of goal specificity (specific goals [easy goal and difficult goal] vs a do your best goal) and goal difficulty (easy goal vs difficult goal) on

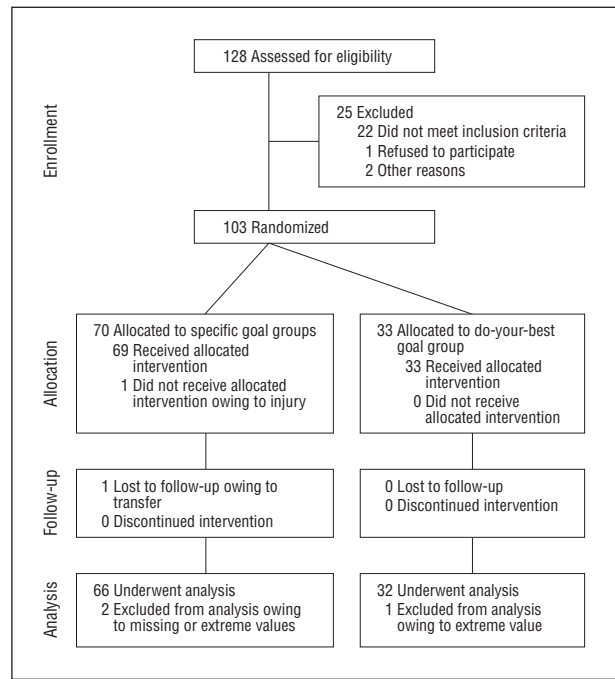


Figure. The CONSORT diagram showing the flow of participants in the study of an interactive dance program with different goals set.

urban Latino children's PA levels and performance in an after-school DDR program. Based on the literature review and previous studies, we hypothesized that children with specific goals would display higher PA levels and better performance than those with do-your-best goals. Second, we hypothesized that specific difficult goals would lead to higher PA levels and better performance than specific easy goals.

METHODS

PARTICIPANTS

Participants included 128 available children from an urban, predominantly Latino elementary school in Salt Lake City, Utah. The CONSORT diagram is shown in the **Figure**. The final sample included 98 Latino children in first through sixth grades (47 boys and 51 girls; mean [SD] age, 8.46 [1.26] years). Most of the students came from low-income Latino families. The specific inclusion criteria for this study allowed children ages 7 to 13 years and from Latino families to enroll. The exclusion criteria for this study were (1) use of medication known to affect body composition, such as growth hormone; and (2) the presence of genetic diseases, accidents, injuries, or illnesses that limit PA participation. The inclusion criteria were verified via a self-reported questionnaire, whereas exclusion criteria were verified through parent consent forms. Participants' attendance in the DDR program was recorded by the research assistants.

RESEARCH DESIGN AND PROCEDURES

A repeated-measures design was used in this study. Specifically, participants' baseline PA levels during the DDR program were measured in the first week, and their baseline performance on the first dance was retrieved from the DDR system (pretest score). Participants were then randomly and evenly assigned to 1 of the following 3 goal-setting conditions by age and sex:

1. Easy goals consisted of a goal 10% higher than the baseline scores based on subjects' improvement potential, which was expressed as baseline score \times 10%. The target score was therefore calculated as baseline score + improvement. For example, a child with 60 steps per minute (SPM) during the DDR program was advised to improve the steps to 66 SPM by the end of week 8.

2. Difficult goals consisted of a calculated 30% improvement from the baseline score for each participant based on the same formula as for easy goals.

3. Do-your-best goals were implemented by instructing participants in this group to do their best.

The improvement rates for easy goals and difficult goals were based on previous research that has used similar goal increments.¹⁰

Informed parental consent and child assent forms were obtained in accordance with the institutional review board of the participating university and school district requirements. Data were collected during the after-school program for 3 semesters. The school had a 45-minute after-school PA program 4 times per week. Approximately 12 to 16 participants were evenly selected from each grade during the program. Participants were paired up at each DDR station. They had a 5-minute warm-up and a 5-minute cool down period during the DDR program. After baseline measurement, participants received feedback about their PA levels and dance performance in the first week. They were then randomly assigned to the goal-setting conditions. Participants in the different goal-setting conditions practiced DDR under the supervision of their teachers. No other participant was aware of the other children's PA levels, performance, or goals, and children were instructed not to discuss this information with their peers. During the 8-week intervention period, a research assistant was present to facilitate the administration and ensure the consistent practice of the DDR program. For example, the research assistant checked whether children stuck with their respective goal-setting conditions every week. At the end of the study, participants' PA levels and performance were measured again (posttest scores).

MEASURES

PA Level

Participants' PA levels were measured using piezoelectric pedometers (NL 1000; New Lifestyles Inc). This model has been shown to be an accurate pedometer for measuring children's PA levels in field settings.²⁰ The validation followed the procedure recommended by Vincent and Sidman.²¹ Specifically, the pedometer was shaken vertically 100 times, and then the error between shaken and recorded steps was examined for each pedometer. Deviation from the 100 shakes for all pedometers was less than 5%. The validation demonstrated that the pedometers could provide accurate step counts. Pedometer step output was expressed as SPM, which was calculated by dividing the total number of steps taken in playing DDR by the number of minutes.²² The students were advised to reset the pedometers to 0 at the beginning of the warm-up and turned in the pedometers at the end of the program. The mean SPM from 3 after-school sessions was used as children's PA level.

DDR Performance

The DDR program is an interactive dance video game that allows participants to physically interact with the program. The participant moved his or her feet to a set pattern, stepping in time to the general rhythm or the beat of a song. While the game was in play, 4 stationary, transparent arrows appeared at the

top of the screen. Other arrows scrolled up from the bottom of the screen and passed over the stationary arrows. When the scrolling arrows overlapped the stationary ones, the participant stepped on the corresponding button on the mat, hitting the button on the mat as the arrow on screen passed the bar. For more complicated songs or levels, steps combined and the participant had to step on more than 1 button at a time. An announcer commented on or praised the participant as the game proceeded. After each game play, points were awarded for speed and accuracy, and the points and number of correct steps in a row added up to a letter grade (ie, F, C, or A). In this study, participants were instructed to select songs with similar tempo at the same difficulty level. Their total points were used as their performance scores. For each DDR station, 2 master dance pads were connected to the monitor. A total of 8 stations were set up in the gym with 2 children playing on each station.

DATA ANALYSES

All the data (ie, body mass index, PA levels, and performance) were entered manually in commercially available statistical software (SPSS, version 15.0; SPSS Inc). We analyzed data in 2 steps. First, descriptive statistics (eg, mean PA levels) were used to describe the sample by goal condition, sex, and prior experience. Second, 1-way multivariate analysis of covariance with gain scores (calculated as posttest - pretest scores) were conducted for PA levels and performance. The independent variable was the goal condition, and the dependent variables were PA levels and performance. The covariate consisted of children's prior experience with DDR. An α level of .05 was set to determine significance.

RESULTS

Thirty children reported that they had prior experiences with playing DDR. Descriptive statistics are reported in the **Table**. Generally, children were moderately active during the DDR program because the mean SPM was approximately 60. However, they demonstrated large variability on the DDR performance based on the raw scores. For example, children's mean pretest performance scores of the DDR on the television was 313 126, with a standard deviation of 240 437. Therefore, children's DDR performance raw scores were converted into the logarithm scores. The boys had more SPM (PA level) than girls, but both sexes had similar DDR performance scores.

The multivariate analysis of covariance yielded a significant main effect for the goal-setting condition (Wilks $\lambda = 0.69$; $F_{4,186} = 9.69$ [$P = .000$, $\eta^2 = 0.17$]) and a significant effect for the covariate (experience) (Wilks $\lambda = 0.91$; $F_{2,186} = 4.69$ [$P < .011$; $\eta^2 = 0.09$]). Follow-up univariate tests indicated that children in the easy-goal (mean score increase, 0.011 [95% CI for mean difference, 0.34-0.67]) and difficult-goal conditions (0.67 [0.51-0.84]) had significantly greater increases in scores on their DDR performance than those in the do-your-best group (0.17 [0.002-0.34]). In a similar way, children's increased PA levels in the easy-goal (mean increase, 10.34 [95% CI for mean difference, 4.32-16.34] SPM) and difficult-goal groups (22.45 [16.43-28.48] SPM) were significantly higher than those in the do-your-best group (0.83 [-5.30 to 6.96] SPM). In addition, children who were provided with difficult goals displayed greater increased PA lev-

Table. Descriptive Statistics for 98 Subjects

Descriptive Variable (No. of Subjects)	Dependent Variable, Mean (SD) ^a	
	PA Level	Performance
Goal condition		
Do your best (n = 32)		
Pretest	58.43 (20.73)	5.91 (0.53)
Posttest	58.93 (14.06)	5.92 (0.33)
Easy (n = 33)		
Pretest	58.99 (16.89)	5.19 (0.44)
Posttest	69.49 (18.83)	5.70 (0.21)
Difficult (n = 33)		
Pretest	52.70 (14.28)	4.97 (0.69)
Posttest	75.31 (17.55)	5.65 (0.27)
Sex		
Boys (n = 47)		
Pretest	61.78 (18.38)	5.14 (0.64)
Posttest	71.49 (18.78)	5.67 (0.24)
Girls (n = 51)		
Pretest	51.99 (15.42)	5.23 (0.54)
Posttest	64.79 (17.02)	5.61 (0.31)
Prior experience		
Without (n = 68)		
Pretest	50.50 (15.42)	4.90 (0.65)
Posttest	66.89 (15.73)	5.57 (0.32)
With (n = 30)		
Pretest	59.41 (17.79)	5.31 (0.51)
Posttest	68.48 (19.15)	5.67 (0.25)

Abbreviation: PA, physical activity.

^aThe scores for performance are the logarithms scores; calculations are described in the "Measures" subsection of the "Methods" section.

els than those in the easy-goal group (95% CI for mean difference, 3.6-20.63).

COMMENT

The present investigation examined the effects of different levels of goal specificity and difficulty on Latino children's performance and PA levels in an after-school DDR program. In reviewing the goal-setting literature on PA, Shilts et al²³ found no studies focusing on children younger than 12 years. Hence, to our knowledge, findings from this investigation represent the first empirical evidence demonstrating the effectiveness of goal-setting techniques in enhancing PA levels and proficiency among children. Consistent with our first hypothesis, we found that students with specific goals displayed higher PA levels and DDR performance than those with do-your-best goals. This finding is consistent with previous research by Nelson,²⁴ who observed a benefit for specific goals rather than nonspecific do-your-best goals in regard to PA attendance. In keeping with tenets of the mechanistic goal theory by Locke,⁷ the efficaciousness of the specific goals (ie, easy and difficult) in the present investigation can likely be attributed to the fact that such goals provided children with clear and objective aims, a focus of direction, and clear performance/PA intentions. This finding also suggests that specific goals may be better than general goals, regardless of the level of goal difficulty, a suggestion consistent with goal-setting research in sport and PA.²⁵ From a practical standpoint, it appears that like other groups, Latino children may benefit from the provision

of specific goals in enhancing PA levels and performance, a finding of particular relevance for minority children in whom obesity levels may be disproportionately high.²⁶

We also found support for our second hypothesis that children who set difficult goals would display increased PA levels and DDR performance than those who set easy goals. This finding is consistent with literature reviews indicating that moderately difficult goals result in enhanced sport²⁷ and work performance.⁸ That DDR performance and PA levels among youth benefited most from difficult (vs easy) goals is also consistent with reports from youth athletes²⁸ and coaches²⁹ regarding a preference for moderately difficult and very difficult goals, respectively. Although coaches may set very difficult goals in an attempt to get athletes to strive to reach their maximal potential, overly difficult goals have been found to lead to frustration and motivational deficits.²⁹ Thus, although findings from the present research suggest the benefit of difficult goals, health care professionals and instructors must be careful in ensuring that appropriately difficult goals are set to optimally motivate children without promoting frustration.

Given the prevalence of inactivity rates among Latino American communities,^{3,4} finding ways to promote and sustain PA remains a significant challenge. Because Latino youth have a disproportionately high risk of overweight, type 2 diabetes, and cardiovascular disease,³ the provision of appropriate goal-setting techniques may be one effective means by which health promotion agents help initiate and sustain PA levels among this segment of the population. Moreover, most of the Latino youth represented in this study were economically disadvantaged. Given the cognitive nature of goal-setting interventions, such a technique may be a cost-effective means for promoting PA in poorer socioeconomic communities. Findings from this investigation also have relevance for health promotion specialists involved in the delivery and implementation of after-school PA programs for youth more broadly. In particular, the findings provide experimental support for the contention by Locke and Latham³⁰ that health promotion agents seeking to increase PA levels and proficiency should use specific, relatively difficult goals as an effective means for increasing adolescent PA. Findings from this investigation provide strong evidence of the effectiveness of goal setting in enhancing actual PA levels and are important insofar as the objective measures of PA and dance performance represent an improvement compared with previous research using self-reported PA measures.^{31,32}

The findings are promising to provide health implications for professionals. Although Latino children had different exercise determinants owing to various cultural backgrounds,³³ a goal-setting strategy for PA promotion is equally effective among this population. Given results from the present investigation, it seems important to ensure that health care professionals are well-versed in appropriate goal setting techniques and implementation. The intervention results suggest the possibility of incorporating cognitive behavioral interventions, like goal setting, into a manageable protocol to be implemented by physical educators and community health leaders, many of whom may not possess (or require) psy-

chological training. Also, the findings reinforce the important role that previous experience plays in promoting children's PA and performance in DDR. Thus, health care professionals should positively reinforce task completion and help ensure that children are able to successfully complete DDR tasks to enhance adolescent PA efficacy and facilitate future PA engagement.

The present findings, although encouraging, have a number of limitations. First, differences in children's PA levels and DDR performance across different age groups were not examined in this study owing to the small sample size, and hence should be a focus for future research. Second, results should be interpreted with caution, given the homogenous population analyzed and the use of a specific PA intervention (ie, DDR) that may not be feasibly implemented in all PA settings (eg, community programs with low funding and in lower socioeconomic areas). To improve PA levels and enhance youth's proficiency in PA, testing multimodal interventions seems prudent, as does more comprehensive training in self-regulation skills (in addition to goal setting). Further research examining the effectiveness of the DDR program in enhancing PA enjoyment and commitment to PA goals seems a worthwhile avenue for future investigation. Finally, as Shilts et al²³ suggest, the use of age-appropriate goal setting (eg, classroom level or group level instead of individual goal setting) should be tested in future goal-setting interventions with children and youth populations. Ultimately, findings from the present investigation suggest that health promotion agents should implement specific and moderately difficult goals in encouraging PA, particularly among Latino communities where high rates of adolescent inactivity pose significant health risks.

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