Associations among children’s situational motivation, physical activity participation, and enjoyment in an active dance video game

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Received 10 March 2012; revised 9 May 2012; accepted 15 June 2012

Abstract

Purpose: The purpose of this study was to examine the relationships between children’s situational motivation and physical activity (PA) levels in a Dance Dance Revolution (DDR) program, and perceived PA enjoyment.

Methods: A sample of 215 elementary children participated in a weekly 30-min DDR program. Children’s situational motivation toward DDR (intrinsic motivation, identified regulation, external regulation, and amotivation) was measured, followed by the measurement of their accelerometer-determined moderate to vigorous PA (MVPA) in DDR. Children then reported their PA enjoyment.

Results: Only intrinsic motivation was positively related with children’s MVPA in DDR and PA enjoyment. However, other motivational beliefs were not significantly related to MVPA and PA enjoyment. Regression analyses further suggested intrinsic motivation was the significant predictor for MVPA and PA enjoyment.

Conclusion: Children who experienced fun and learned new things when playing DDR reached high PA levels in DDR, as well as developed generalized feeling states of enjoyment.

1. Introduction

Physical inactivity and overweight/obesity are prevalent among children and adolescents in the USA.1,2 For example, the percentage of overweight children and adolescents was 31.7%, and the percentage of obese children and adolescents was 16.9% in 2007–2008.1 The epidemic of physical inactivity and overweight/obesity among this target population is considered an independent risk factor for cardiovascular and other chronic diseases as well as a major contributor to adulthood obesity.3 Regular participation in physical activity (PA) has been identified as an important avenue to prevent childhood obesity. Strategies to promote children and adolescents’ PA participation are therefore one of the key components in the treatment of childhood obesity. In addition, participation in regular PA may improve children’s psychological well-being.3,4 Thus, motivating children to participate in and adhere to PA is of clear importance. To this end, it is critical to understand the associations among children’s motivation, PA levels and correlates (e.g., enjoyment) of PA involvement.

The application of self-determination theory6 has proven fruitful in explaining individual’s situational motivation and achievement behaviors in the context of school-based PA programs. Therefore, this theory has been recommended in understanding children’s situational motivation, and PA
correlates and behaviors. Based upon self-determination theory, three types of behavioral regulations (i.e., reasons for acting) are considered vital in understanding the initiation and regulation of behavior: intrinsic motivation, extrinsic motivation, and amotivation. These motivation types lie adjacent along a self-determination continuum with an individual becoming increasingly self-determined when he/she moves from amotivation to intrinsic motivation.

According to self-determination theory, intrinsic motivation refers to the participation in activities for their own sake or conducted for their inherent enjoyment and satisfaction. In contrast to intrinsic motivation, extrinsic motivation is characterized by an individual’s goal of action being directed by some separable consequences (e.g., reward and punishment), and it includes several regulatory styles such as identified regulation and external regulation. Specifically, identified regulation reflects behaviors that occur by individuals’ acceptance of certain activities as important to their personal goals and values. It is a less self-determined motivational type than intrinsic motivation, as there remain external outcomes associated with the performance of an activity (e.g., exercising for the feeling of relaxation it induces). External regulation is the least self-determined extrinsic regulation. It refers to actions carried out in order to gain an external reward or avoid punishment. Finally, amotivation is the least self-determined construct in the theory. Amotivation is apparent where there is a lack of intention to act and a relative absence of motivation. Along the continuum, intrinsic motivation and identified regulation represent higher levels of self-determined motivation and are expected to lead to positive consequences. By contrast, external regulation and amotivation represent lower levels of self-determined motivation and are predicted to result in negative consequences. Empirical studies indicate that intrinsic motivation and identified regulation tend to promote children’s PA levels and PA enjoyment, and lead to greater intentions of being physically active in after-school activities. In contrast, children with lower levels of self-determined motivation (i.e., external regulation and amotivation) have been shown to display low PA levels or lack of intention to participate in after-school PAs.

In recent decades, traditionally sedentary video games have been highlighted as one among a number of factors implicated in children’s sedentary lifestyles and the associated rates of high childhood obesity. Despite the negative impact of traditionally sedentary video games, the recent advent of exergaming or active video games has the potential to help individuals, especially children, in promoting a healthy lifestyle as they require individuals’ to be physically active while playing. Specifically, the fast growth of interactive video games (e.g., Dance Dance Revolution (DDR), Wii Fit, and Kinect sport) has led to the development of new exercise interventions which hold the possibility of impacting school-based PA programs. For example, DDR combines real physical dancing requiring fast-foot movement with energetic music and visuals. It attracts children’s interests and requires children move their body to play the games, thus DDR can serve as an important bridge between children’s enjoyment and the promotion of their PA levels. DDR has a built-in workout mode that allows players to track the effectiveness of their physical movement and caloric expenditure as they play, and is therefore considered an effective approach to promote PA. Accordingly, DDR has been recognized by researchers as a potential tool for promoting a healthy lifestyle and fighting childhood obesity. Currently, DDR is being widely used as a novel exercise intervention strategy for school-based PA programs. However, most current studies appear to be one-dimensional (e.g., effect of DDR on energy expenditure or general motivation) and do not explore the relations among children’s situational motivation and PA outcomes when playing DDR. Given the recognized importance of motivation and enjoyment to adolescent PA, understanding the relations between self-determination constructs and DDR involvement is important for intervention efforts aimed at the prevention of childhood obesity.

Therefore, the purpose of this study was to examine the relationships between children’s situational motivation toward DDR and PA levels in a DDR class within a school-based exercise program, as well as between their situational motivation toward DDR and perceived enjoyment toward general PA. Based upon the literature review and previous studies, the following hypotheses were proposed. First, children with higher levels of self-determined motivation (i.e., intrinsic motivation and identified regulation) would demonstrate higher PA levels when playing DDR, while low levels of self-determined motivation (i.e., external regulation and amotivation) would lead to lower PA levels when playing DDR. Second, children with higher levels of self-determined motivation would report higher general PA enjoyment, whereas lower levels of self-determined motivation would result in lower levels of general PA enjoyment.

2. Methods

2.1. Participants

A prospective design was employed in this study, whereby subjective psychometric survey and objective PA data were collected during different periods of the DDR intervention. A total of 215 third through sixth grade urban school children (age, 11.2 ± 1.11 years (mean ± SD), range = 8–14 years; 112 boys, 103 girls) from the Mountain West region participated in this study. The participants came from a variety of cultural and ethnic backgrounds, and had the following self-report ethnic breakdown: White-American (n = 157), African-American (n = 6), Hispanic American (n = 14), Asian American (n = 13), others (n = 24), and undeclared (n = 1). The participants had a weekly 30-min physical education class. The class size ranged from 24 to 30 students. In the spring of 2010, the principal investigator initiated a DDR program at the school that aimed to promote children’s PA participation. To successfully implement the program, the principal investigator and the school physical education coordinator had several meetings prior to the intervention, and decided to offer the program on Thursday for the target
children for 30-min every week for 18 weeks. The DDR program occurred in addition to children’s regular 30-min weekly physical education class. All third through sixth grade children were eligible to participate in the DDR program. Since the DDR program was integrated in the school’s curriculum and had very limited physical risks, all parents gave the consent for this study. Thus, the majority of target children participated in the study except those who were ill during the data collection period.

2.2. DDR intervention

A total of six DDR stations were set up in the gym prior to children’s arrival. After the classroom teachers let the children into the gym, the research assistants took attendance and led a 2-min warm-up. Children were then assigned to the DDR stations based on their genders, because dance is usually deemed as a female appropriate activity and girls may have different dance skill levels from boys. More specifically, there were up to five girls in one station, and four to five boys in another DDR station at any one time. On the first day, the principal investigator and the research assistants introduced this study and demonstrated how to play DDR. During the intervention program, the research assistants walked around the stations to monitor and encourage children to stay on task when playing DDR.

When playing DDR, a player moved his/her feet to a set pattern, stepping in time to the general rhythm or beat of a song. While the game was in play, there were four stationary (up, down, left, and right), transparent arrows 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 player stepped on the corresponding arrows on the dance pad. A “jump” step involved pressing two arrows simultaneously. In this way, the game encouraged the player to dance a pre-choreographed series of steps to the beat of the music. Each step was given a rating that indicated how close to the beat the step was. From best to worst, these ratings were PERFECT, GREAT, GOOD, BOO, and MISS. Successfully hitting the arrows in time with the music filled the “Dance Gauge”, while failure to do so drained it. If the Dance Gauge was fully depleted during game play, the student failed the song, usually resulting in a game over.

2.3. Procedures

The procedures were approved by the University Institutional Review Board and the school district. Written parental consent forms and child assent forms were obtained prior to this study. As indicated, children participated in a 30-min DDR program for 18 weeks beyond their 30-min weekly physical education class every week. Children’s situational motivation in DDR was measured via an established questionnaire in the eighth week after they were familiar with DDR. Three DDR sessions were scheduled to assess children’s accelerometer-determined PA levels in the DDR session in the following 3 weeks (i.e., weeks 9—11). Then children self-reported their perceived enjoyment toward general PA during the semester in the sixteenth week.

Two research assistants were trained to assist with the data collection of the accelerometers and questionnaires. Specifically, the research assistants provided instructions for the situation motivation questionnaire on the first day of data collection in the eighth week. The accelerometers, which were attached to elastic waist belts, were distributed to the children in the ninth, tenth and eleventh weeks. The accelerometers were worn on the left side of children’s waist, and resembled a beeper. In the ninth week, each child was assigned an identification number matched with the number on his or her accelerometer. The research team assisted the students to make sure the accelerometers were attached correctly. In the following weeks, the students were instructed to wear the same accelerometers. In the sixteenth week, children completed another short questionnaire measuring their PA enjoyment at the end of the DDR session. Additionally, the time for participation during DDR sessions was monitored and recorded.

2.4. Instruments

2.4.1. Situational motivation

To assess the participants’ situational motivation in DDR, the 16-item Situational Motivation Scale was used to measure children’s intrinsic motivation, identified regulation, external regulation and amotivation. Integrated and introjected regulations were not measured in this scale because: (1) conceptual distinctions have largely failed to receive statistical support, and (2) it is difficult for children to differentiate the real meaning between these constructs and their adjacent levels (e.g., introjected vs. external regulation). In this study,
participants were asked to rate how important each of the statements was to their personal motives to engage in DDR, by responding to the stem, “Why are you currently engaged in today’s DDR?” A 7-point Likert type scale (1 = strongly disagree, 7 = strongly agree) was used for all responses. Sample statements included: (a) because I think that playing DDR is interesting (i.e., intrinsic motivation); (b) because I am doing it for my own good (i.e., identified regulation); (c) because I am supposed to do it (i.e., external regulation); and (d) there may be a good reason to play DDR, but personally I don’t see any (i.e., amotivation). The average score of each of the 4-item scales were used for children’s intrinsic motivation, identified regulation, external regulation, and amotivation. The scale has demonstrated acceptable validity and reliability in physical education classes.20

2.4.2. PA levels
An objective measurement of children’s PA levels in DDR was obtained when children wore the ActiGraph GT1M accelerometers (Pensacola, FL, USA). The ActiGraph GT1M was worn on a waistband or in a clip pouch at the midaxillary line of either hip. Accelerations of the ActiGraph GT1M are converted into activity counts, and activity counts increase linearly with magnitude of accelerations. Activity counts can be summed and recorded for a user-specified epoch ranging from 5 s to 1 min. The sum of activity counts in an epoch is linearly related to activity intensity and can be classified into intensities of PA based on validated established activity count cut points. Most recently, researchers have demonstrated acceptable validity and reliability of ActiGraph GT1M when used with children and adolescents.21 Given the duration (short-period) of the DDR class and the aims of this study, activity counts were measured in 30 s epochs, and in-class PA levels were quantified as average activity counts per 30 s interval (average count/30 s) for the intensities of the activities. Cut points established by Puyau et al.22 were applied to the data: (a) 0–399 counts per 30 s = sedentary; (b) 400–1599 counts per 30 s = light; and (c) ≥ 1600 counts per 30 s = moderate to vigorous physical activity (MVPA). In this study, students’ percentage of time spent in MVPA was used as the outcome variable.

2.4.3. Enjoyment toward PA
To measure children’s perceived enjoyment toward general PA, an established scale by Prochaska et al.23 was used. Specifically, children reported their PA enjoyment by rating the item “I enjoy doing PA” anchored by a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The score of this item was utilized as children’s PA enjoyment.

2.5. Data analyses
Data were analyzed in four steps. The first step involved testing Cronbach’s α coefficients to ensure the internal consistency of the situation motivation measures. The second step involved calculating means and standard deviations for children’s situational motivation toward DDR, PA enjoyment, and percentage of time spent in MVPA in DDR. The third step involved testing Pearson correlations to evaluate the relationships among children’s situational motivation, percentage of time spent in MVPA, and PA enjoyment. The last step involved using simultaneous multiple regression analyses to determine the motivation predictors for children’s percentage of time spent in MVPA and PA enjoyment, respectively. In particular, two simultaneous multiple regression analyses were performed with all the predictors being entered into the models simultaneously to predict the dependent variables. An α level of 0.05 was set for all statistical analyses in SPSS software, version 15.0 (SPSS, Inc., Chicago, IL, USA).

3. Results
3.1. Descriptive statistics
The four dimensions of situational motivation were tested for internal consistency. Cronbach’s α coefficients for the subscales are shown in Table 1. As presented, the coefficients for the four measures exceeded the minimum recommended value of 0.70, suggesting that these measures were appropriate for the target population in this study. Table 1 also presents the descriptive statistics for the sample. Apparently, the children in this study demonstrated moderately high levels of self-determined motivation toward DDR, as the mean scores of the higher levels of self-determined motivation were above the midpoint (i.e., 4 for intrinsic motivation and identified regulation) while the mean scores of external regulation and amotivation were below the midpoint. The children also reported relatively high PA enjoyment. Nevertheless, the children were not very active when playing DDR, because the average percentage of time spent in MVPA was only 29.99% (Table 1).

3.2. Correlation analyses
Correlation analysis indicated that, among the four dimensions of situational motivation, the two high level of self-determined motivation (intrinsic motivation and identified regulation; \( r = 0.67 \)) were significantly and positively related
to each other, while the two low level of self-determined motivation beliefs (external regulation and amotivation; \( r = 0.53 \)) were positively related to each other (Table 1). Intrinsic motivation was negatively correlated to external regulation and amotivation. Also, as presented in Table 1, only intrinsic motivation was positively and significantly related with percentage of time spent in MVPA (\( r = 0.16, p < 0.05 \)) and PA enjoyment (\( r = 0.19, p < 0.01 \)).

3.3. Multiple regression analyses

As shown in Table 2, our data revealed that, for MVPA in DDR, intrinsic motivation positively predicted children’s MVPA in the model, \( F(1, 159) = 4.40, p < 0.05 \), and explained approximately 4% of the variance. While identified regulation and the two low level of self-determined motivation failed to emerge as significant predictors when being entered into the model. Similarly, PA enjoyment was significantly predicted by intrinsic motivation in the model, \( F(1, 208) = 7.75, p < 0.05 \), accounting for 4% of the variance. Identified regulation, external regulation and amotivation, however, were not significant predictors when being entered into the model.

4. Discussion

The present study investigated the associations among third through sixth grade elementary school children’s situational motivation toward DDR, PA levels in DDR, and general PA enjoyment. Prior to the main analyses, support was provided for the internal consistency of the situational motivation scale used in this study, a finding consistent with previous research.\(^5^,\(^6^,\(^11^,\(^20\))\) According to the descriptive analyses, children reported moderately high levels of self-determined forms of situational motivation toward DDR (i.e., intrinsic motivation and identified regulation) and relatively low levels of less self-determined motivations (i.e., external regulation and amotivation). They also displayed high level of perceived enjoyment toward PA. The results suggested, however, this group of children were not very physically active when playing DDR.

Based upon the correlation analyses, children’s intrinsic motivation was positively associated with identified regulation, but negatively related to external regulation and amotivation. Children’s external regulation and amotivation were also positively correlated. This pattern of results are in line with the simplex-ordered correlation structure proposed in self-determination theory.\(^6\) In particular, intrinsic motivation is expected to be more positively associated with identified regulation than with external regulation or amotivation. That such correlations were present in the current investigation, along with the fact that intrinsic motivation was negatively correlated with external regulation and amotivation, lends further credence to the contention that the various motivational types proposed in self-determination theory lie along a continuum of relative autonomy.

A key finding to emerge from the present study was that students’ intrinsic motivation was positively associated with their time spent in MVPA and PA enjoyment, although the relationship was not very strong. Regression analyses further revealed that intrinsic motivation predicted DDR PA levels and general PA enjoyment. These findings add to the wealth of evidence highlighting the benefits of intrinsic motivation across various life domains\(^6\) and are consistent with previous PA research indicating that students with higher intrinsic motivation demonstrate greater effort, enjoyment, and increased PA levels.\(^7^,\(^23^,\(^24\))

Consistent with our prediction that higher (but not lower) levels of self-determined motivation would predict PA levels in DDR and PA enjoyment, no correlations were found between external regulation, amotivation and PA levels in DDR or PA enjoyment. As amotivation represents a state of disinterest, it is certainly logical that an antipathy towards DDR would either be negatively or not significantly associated with MVPA in DDR and general PA enjoyment, an explanation in line with previous findings.\(^25\) Moreover, as enjoyment and fun has been recognized as a key factor initiating youth PA involvement,\(^7,\(^23^,\(^24\))\) it is not entirely surprising that a feeling of having to participate in the DDR program (i.e., external regulation) was not related to DDR activity levels or general PA enjoyment. Similarly, the fact that adolescents voluntarily participated in the DDR program, meant that externally regulated perceptions such as “not having any choice to participate” could not have been a motive for DDR involvement, and hence had no bearing on PA levels or enjoyment.

A finding that was somewhat surprising was the fact that identified regulation did not predict MVPA and PA enjoyment. One possible explanation for this relates to the developmental level of children in this study. It seems likely that children between the ages of 8–14 might not consider or personally endorse functional outcomes associated with PA as key reasons driving or initiating their PA involvement. For example, the notion of “doing it (DDR) for one’s own good” may be incompatible with the psychological mindset of a child.

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### Table 2

<table>
<thead>
<tr>
<th>Outcome variables</th>
<th>Predictors</th>
<th>( \beta )</th>
<th>( B )</th>
<th>Confidence interval (for B)</th>
<th>( p ) value</th>
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<td>MVPA</td>
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<td>Enjoyment</td>
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<td>0.03–0.28</td>
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<td>-0.11–0.10</td>
<td>0.92</td>
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</table>

Note: \( \beta \) values are standardized regression coefficients from the regression analysis. *\( p \) value is at the significant level. MVPA = moderate to vigorous physical activity. B values are unstandardized regression coefficients from the regression analysis.
who, as indicated above, is likely more interested in whether being active offers the potential for fun and enjoyment rather than whether such engagement is “good for oneself” (i.e., for identified regulations). Indeed, this explanation is consistent with some previous adolescent PA research indicating intrinsic (but not other regulatory styles) to be associated with PA levels.26

Based on the findings of the study, it can be suggested that children who are engaged in situations in which they experience fun when playing DDR will reach higher MVPA levels, as well as develop generalized feeling states of enjoyment in general PA. The findings in this study have significant implications for teaching practice. It may be important to conduct PA interventions that raise children’s intrinsic motivation to promote PA enjoyment and PA levels. As highlighted in self-determination theory, environments or interventions that conduct towards satisfaction of children’s needs for competence, autonomy, and relatedness are likely to increase children’s intrinsic motivation for PA.6 Proven strategies for addressing adolescent competence needs (and subsequent intrinsic motivation for PA) may include the provision of opportunities to experience successful PA performance, the receipt of positive feedback based on mastery of particular skills, and the opportunity to set personally relevant goals.27 Moreover, the provision of choice within a clear structure and a meaningful rationale behind the conduct of particular activities may promote perceptions of autonomy and consequent intrinsic motivation for PA involvement.27 Last, ensuring that kids feel connected (e.g., small-group activities) and that they receive expressions of empathy or acknowledgment of their concerns can foster feelings of relatedness and intrinsic motivation towards PA.27

Several study limitations were presented in the current investigation and should be noted. First, due to the school’s major emphasis on the core curricula such as language arts and math, only a single 30-min DDR program was added per week in addition to the weekly 30-min physical education class. The total PA time for children every week was well below the national standards,28 and therefore the effectiveness of the DDR intervention on daily PA participation was not assessed. Future study may expand the intervention program to ensure children have appropriate PA time. Second, children rotated between the master dance pads and the practicing dance pads when playing DDR, but their actual time on the master dance pads and practicing pads was not assessed in this study. That children on master dance pads received instant feedback whereas children on the practicing pads had no feedback, may have impacted children’s attitudes, motivation, and PA levels.29 Researchers should investigate the influence of different dance pads on children’s motivation and PA behaviors. Additionally, although PA enjoyment has been identified as a mediator for daily PA participation,30 it is critical to use objective daily PA levels as the outcome variable. We only measured children’s PA enjoyment in this study due to pragmatic limitations, namely, a lack of sufficient accelerometers and the limited number of research assistants. Thus, we recommend the use of objective measures of daily PA levels to reflect children’s actual PA behaviors in future research. Lastly, the impact of gender or body mass index was not investigated in this study. It is suggested that these potential influences be examined in future studies to further explore the moderating effects of gender or body mass index on the outcome variables.

5. Conclusion

In summary, findings from this investigation indicate the importance of intrinsic motivation in promoting general PA enjoyment and PA levels in games and activities such as DDR. Ensuring that PA interventions support children’s need to feel competent, autonomous, and related (i.e., connected) to others while engaged in PA exercises such as DDR, may be instrumental in enhancing intrinsic motivation and subsequent PA involvement and enjoyment.6,8 As DDR is a game that offers challenge, self-directed goals, and the possibility of interaction with others, it would seem an effective way for meeting children’s psychological needs, an important step in promoting intrinsic motivation and subsequent PA involvement and enjoyment. Further research examining the implications of interventions supportive of children’s competence, autonomy, and relatedness needs on their intrinsic motivation and PA levels/enjoyment is warranted.

References


