The Physical Educator Vol. 69 • pp 20-35 • 2012

The Effect of Course Configuration of the Mile Run on Preference and Performance of Elementary School Runners

Adam Sheppard, Daniela A. Rubin, Clay P. Sherman, Debra L. Patterson

Abstract

Currently, there is no standardized course configuration for the administration of the mile run/walk (MRW) test. This study assessed the effect of altering the MRW course configuration on student preference for configurations, student performance during the test, and perception of exertion after the test. Participants completed the MRW test under two different course configurations (5-lap vs. 10-lap). Participating students were divided into an experimental group (n=77) running a 5-lap and a 10-lap MRW configuration and two control groups: a 5-lap MRW configuration (n=17), and a 10-lap MRW configuration (n=21). Before and after running both configurations, students indicated a preference toward the 5-lap MRW. No significant differences were observed for overall MRW time, although the average 10-lap time was lower than the 5-lap time. No differences between track configurations were observed for perceived exertion, perception of running performance or enjoyment. Findings suggest that altering the dimensions of the MRW has no effect on student performance.

Adam Sheppard is affiliated with the University of California, Irvine; and Drs. Daniela Rubin, Clay Sherman, and Debra L. Patterson are on the faculty at California State University, Fullerton.

In California, schools are required to administer a physical performance test to all fifth, seventh, and ninth grade students. The FITNESSGRAM (Meredith & Welk, 2007) is the adopted physical performance test. To assess aerobic capacity, the test offers two options: the one-mile run/walk test (MRW) or the progressive aerobic cardiovascular endurance run (PACER). In the FITNESSGRAM manual, the only criterion for the MRW test is the total distance traveled, one mile (Meredith & Welk, 2007). In an evaluation of California physical fitness assessment data (Beets & Pitteti, 2004), the most frequently reported cardiovascular fitness measurement was the MRW (59.8%). While comparisons were made between MRW test scores, no information was provided on methodology for administration of the test, with the exception that the MRW test was performed "on a flat running course" (Beets & Pitteti, 2004).

While the MRW test is valid (Buono, Roby, Micale, Sallis, & Shepard, 1991), reliable for the same course configuration (Buono 1991; Rikli, Petray, & Baumgartner, 1992), and was used in various studies (Beets & Pitteti, 2004; Eisenmann, Welk, Ihmels, & Dollman, 2007; Hopple & Graham, 1995; Xiang, Bruene, & McBride, 2004; Xiang, McBride, & Bruene, 2004, 2006), the configuration of the test was either not stated (Beets & Pitteti, 2004; Eisenman et al., 2007) or inconsistent across studies. The course configuration varied from a three-lap (Xiang et al. 2004a) to a four-lap (Buono et al. 1991) to an eight-lap MRW (Mahar et al., 1997; Rikli, et al., 1992). Open space at elementary schools varies in shape and size, so it is reasonable to believe that the MRW course configuration is also different between schools. To compare performance scores across studies or between schools, it would be helpful to know if changing the configuration of the MRW course alters performance in this test, affecting its reliability.

As the shape and size of a course is altered, the number of turns a student makes during the MWR also changes (i.e., a student running on a five-lap course will make fewer turns than a student running on a ten-lap course). Sadalla and Magel (1980) showed in college students that a path with more turns was perceived to be longer than a path with fewer turns, even for paths of the same overall length. However, to our knowledge, this phenomenon has not been assessed in children. In addition, while estimating a straight-line distance in a large field, young children consistently underestimated the total distance between fixed points (Da Silva, 1983). Therefore, differences in course dimensions may also influence student perception of

distance, which in turn may influence preference toward one course configuration over another. Additionally, altered course dimensions may influence student's perception of effort and enjoyment during the test. As Hopple and Graham (1995) stated, modifications in the administration of fitness tests may increase student enjoyment during the test.

In addition to influencing the estimation of distance traveled, the number of turns in the MRW course may also influence student pacing during the test. In a process described by Ulmer (1996) as "teleoanticipation," the knowledge of the endpoint in an exercise bout factors into the pace-setting strategy of the individual engaged in the activity. Building upon this idea, St Clair Gibson et al. (2006) described that the teleoanticipation-pacing center in the brain monitors various inputs (environmental factors, heart rate, body temperature, speed, metabolic rate, etc.) to adjust the individual's pace to avoid failure of any physiological system prior to the completion of the activity. As the dimensions of the MRW course are decreased, students will pass course landmarks (i.e., corners) more frequently, so it is possible that the students will be better able to pace themselves because of increased environmental stimuli, perhaps improving performance.

Another environmental factor associated with any modifications to MRW course dimensions is the average distance between runner and observer. Recent studies have shown a relation between the distance between and observer and student and the student's physical activity levels in physical education settings (Patterson & van ders Mars, 2008). In smaller MRW course configurations, the average distance between observer and student is decreased, so it possible that a closer proximity to the observer timing the MRW trial may increase the pacing strategy of the students during the test.

The purpose of this study was to examine how varying course configuration during the MRW test affected student perception of the test and performance during the test. The research question had three components. First, which configuration do students prefer: a smaller (10-lap) course or a larger (5-lap) course? Second, does altering the course configuration influence the physical performance, as measured by time, of students during the MRW? Third, does altering the course configuration influence student perception of effort, perception of performance, or perceived enjoyment?

Methods

Participants

Fifth-grade students (N = 125) were recruited to participate in this study from two separate schools in a large Southern California school district. The two schools were purposefully selected because they had a large enough field to accommodate two MRW course configurations side by side. While the field areas were large, one of the fields was only able to accommodate a 5-lap configuration and a 10-lap configuration without overlap, so these were used as the comparison configurations at both school sites. Student participation in the study was voluntary, and permission was obtained using consent and assent forms approved by the University Institutional Review Board. Students were allowed to withdraw from the study at any time, and only scores from students with complete sets of data were used for analyses. Ten students did not complete all four trials due to a variety of reasons (i.e., absence, withdrawal, picture day).

Measures

Anthropometric measures. Height (cm) and body weight (kg) were measured for all participants using a stadiometer (Seca, Hamburg, Germany) and a digital scale (Lifesource, San Jose, CA) respectively. These measures were used to make comparisons across control and experimental groups to ensure like characteristics. Descriptive statistics for all participants are found in Table 1.

Perception of MRW course preference. To assess student preference of MRW course configuration, students were asked to make a visual comparison of a 5-lap MRW configuration and a 10-lap MRW configuration side-by-side. To provide a visual representation of each course configuration, cone markers were placed 10-15 meters apart along the perimeter of the equivalent of one lap (1056 feet vs. 528 feet, respectively). Each course was rectangular, and the dimensions of both configurations were proportional. Figure 1 diagrams the relationship between the two course configurations. Participants stood between the two courses (indicated by "X") and were asked, "If you had the option to run ten laps around the cones on your right, or five laps around the cones on your left, which one would you prefer?" Student responses were recorded as either "5" or "10."

MRW performance. MRW performance was measured in seconds. Time measurements were recorded using a tracking chart

Table 1

Descriptive Characteristics of Participants by Classroom

Classroom	Group	Number	Age (yrs)		Height (cm)		Weight (kg)	
			M	SD	M	SD	M	SD
School A								
1	CTRL5	Males (n = 9)	10.56	0.73	143.00	7.51	44.40	12.02
		Females (n = 8)	10.50	0.54	140.94	10.35	39.41	16.89
2	CTRL10	Males (n = 12)	10.17	0.39	140.88	8.69	40.97	12.12
		Females (n = 9)	10.22	0.44	144.28	7.90	37.49	8.43
3	E 5-10	Males (n = 8)	10.50	0.54	145.88	5.81	47.03	8.61
		Females (n = 8)	10.50	0.54	140.25	5.65	36.46	5.83
4	E 10-5	Males (n = 10)	10.70	0.68	144.70	9.52	45.45	14.02
		Females (n = 1)	11.00	0.00	153.00	0.00	43.80	0.00
School B								
5	E 5-10	Males (n = 8)	10.88	0.84	141.88	7.95	40.43	10.02
		Females (n = 11)	10.55	0.52	145.23	7.00	45.21	16.71
6	E 10-5	Males (n = 11)	10.64	0.67	146.09	8.39	45.78	20.62
		Females (n = 20)	10.25	0.44	142.80	6.84	39.21	10.60

Notes: E = experimental group; CTRL = control group; M = mean; SD = standard deviation

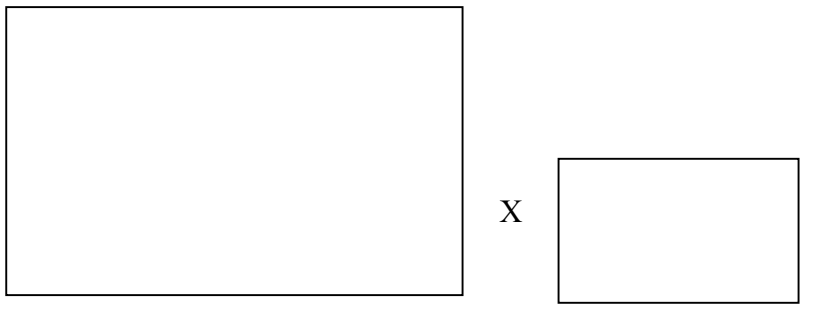

Figure 1. The 5-lap track was 1056 feet in perimeter (328 ft x 200 ft) and the 10-lap track was 528 feet in perimeter (164 ft x 100 ft)

designed for each course configuration. Time was recorded for every lap during the 5-lap MRW, while time was only recorded for even numbered laps for the 10-lap MRW (a check indicated the student had completed odd numbered laps). Each fifth mile split time was recorded to assess pacing during the MRW trials.

Perception of exertion. The Children's OMNI scale (Robertson, 2004; Robertson et al., 2000) was used to measure rate of perceived exertion (RPE) following MRW trials. The scale ranges from 0-10, with 0 being "not tired at all" and 10 being "very, very tired." In addition to numbers, the scale also has four pictures (at zero, 3, 6, and 10) of a young boy in various stages of fatigue (with "10" slouched over holding his knees). The Children's OMNI scale has been used to assess perceived exertion in elementary school-aged students (Utter, Robertson, Nieman, & Kang, 2002), and is correlated with $\%VO_{2max}$ ($r = 0.42$) and V_E/VO_2 ratio ($r = 0.43$).

Perception of effort and enjoyment. Upon completing each MRW trial, students completed a two-item, pencil and paper questionnaire. The first item was, "I ran my hardest today," and was scored using a 5-point scale (Xiang et al., 2004a): (1) "YES," (2) "yes," (3) "?," (4) "no," and (5) "NO," The second item was, "I enjoyed running today," and was scored using the same scale as for the first question. Scores from the first item were used as an indirect assessment that students had performed their best, and scores from the second item were used to indicate perception of enjoyment.

Procedure

As the MRW test is commonly administered with groups of students, participants in the present study were randomly assigned by classroom to either the experimental group or one of two control groups. One classroom ($n = 17$) from School A was assigned to the 5-lap MRW control group (CTRL5) while another classroom ($n = 21$) from the same school was assigned to the 10-lap MRW control group (CTRL10). Two classrooms from School A and two classrooms from School B served as the experimental group ($n = 77$). Students participated in a series of four sessions at their respective school sites. All sessions were completed between three and seven days following the previous session.

Sessions one and four. The first and fourth sessions consisted of an assessment of the MRW course preference. The first session included an introduction to the Children's OMNI Scale and measurements of height and weight.

Sessions two and three. Students were brought out to the field in groups of 8-13 and were told that they would be running one mile around the course configuration specified for their respective group (5-lap or 10-lap). Students in the experimental group completed MRW trials in a counterbalanced fashion. For the first MRW trial (session two), one class from each school completed a 5-lap MRW while the other two classes completed a 10-lap MRW. On the second MRW trial (session three), students completed the opposite MRW configuration. Students in the control groups ran both MRW trials on the same configuration, either the 10 lap MWR or the 5-lap MRW.

Two investigators supervised each MRW trial with each monitoring half of the students, who wore numbered vests to correspond with the time-keeping charts. Each investigator recorded time measurements of four to seven students during each MRW trial. Students were instructed to wear comfortable running shoes on days of MRW trials. Students were reminded to remove any heavy articles of clothing (sweatshirts, jackets, etc.) prior to running. As teachers at each of the two school sites indicated that they did not offer a warm up prior to running activities, the students were not offered a warm up to mimic the practice of the teachers. While running the 5-lap MRW, students were informed when they had one lap remaining, whereas students running the 10-lap MRW were informed when they had two laps remaining. Upon completing the MRW trial students indicated their level of perceived exertion using the Children's OMNI Scale. Once all students in the group had completed their MRW trials, each student finished the two-item questionnaire assessing perception of effort and enjoyment during the test.

Analytic Strategy

Statistical analyses were run using the Statistical Package for Social Sciences (SPSS, Chicago, IL) software program. Descriptive statistics were computed for age, height, and body mass by classroom. Statistical significance was set at an alpha level of $p < 0.05$ for all tests.

To determine student preference of the 5-lap or 10-lap course configurations, frequencies were calculated from course preference indicated in sessions one and four. Significant differences between course preference frequencies were assessed using the McNemar's test.

To compare student MRW performance time between the 5-lap or 10-lap course configurations, a paired-samples t-test was used. Significant differences between MRW split times between the 5-lap or 10-lap track configurations were assessed using a 2 (course configuration) by 5 (split-times) repeated measures analyses of variance with a Bonferroni adjustment for pairwise comparisons.

To contrast rank order responses of the two-item, post-run questionnaire ("I ran my hardest," and "I enjoyed running today") between the 5-lap or 10-lap course configurations nonparametric statistics were used. Significant differences between the 5-lap or 10-lap MRW trial questionnaire responses were assessed using Kendall's W tests for each of the two items.

To evaluate test-retest reliabilities of MRW total time and RPE for each track configuration (five-lap and ten-lap), intraclass correlation coefficients were calculated. Follow-up paired-samples t-tests were used to confirm no significant difference between the two MRW trials of the control groups for the MRW total time and RPE measurements.

Results

A series of one-way ANOVAs revealed no differences ($p > .05$) in age, gender, height, or weight between the control groups and the experimental group.

Results for the Control Groups (CTRL5 and CTRL10)

Course preference. Prior to running both MRW trials, 55.0% of the students in CTRL5 and 60.9% of the students in CTRL10 stated they would rather run on the 5-lap course configuration. There was no significant change in course preference for the control groups following the two MRW trials. After completing both trials, 80% of the students for CTRL5 and 65.2% of the students in CTRL10 stated they would prefer to run the 5-lap mile over a 10-lap. McNemar's tests revealed no significant difference between track preference before or after the two trials for CTRL5 ($p > .05$) and CTRL10 ($p > .05$).

Mile run performance time. Paired-samples t-tests revealed no significant difference between the two MRW trials for CTRL5 ($p > .05$) or CTRL10 ($p > .05$). Test-retest reliability of the mile run for both track configurations was estimated with an intraclass

correlation coefficient. The coefficients were $R = 0.91$ for CTRL5 and $R = 0.76$ for CTRL10, indicating acceptable reliability for both course configurations (Rikli, et al., 1992).

Perception of effort and perception of enjoyment. The reliability of the RPE scores were $R = 0.59$ for CTRL5 and $R = 0.67$ for CTRL10. Kendall's W Tests revealed no significant differences between the two trials in response to the "I ran my hardest" item for either CTRL5 or CTRL10 ($p > .05$ for both). Also, no differences were observed in the "I enjoyed running today" item ($p > .05$ for both). Means and standard deviations for CTRL5 and CTRL10 measures are reported in Table 2.

Results for the Experimental Group

Track preference. A McNemar's test revealed no significant difference between student preferences before or after running both MRW trials ($p > .05$). Prior to running on both track configurations, 56.8% of students stated that they would rather run on the 5-lap course configuration. After running on both course configurations, 56.8% of students stated they preferred to run the 5-lap MRW over the 10-lap MRW.

Table 2

Means and Standard Deviations for MWR Results for Control Groups

MRW Trial	MRW Time (sec)		RPE (1-10)		Hardness (1-5)		Enjoyment (1-5)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
CTRL5								
5-lap #1	678.00	111.71	5.42	3.04	1.88	1.32	1.71	1.16
5-lap #2	690.39	94.22	5.22	3.08	2.00	1.37	1.82	1.13
CTRL10								
10-lap #1	695.87	80.00	6.70	1.87	2.62	1.28	1.62	0.81
10-lap #2	675.00	101.91	6.48	2.50	2.81	1.29	1.57	0.68

Notes: CTRL5 = 5-lap control group (n = 17); CTRL10 = 10-lap Control Group (n = 21); M = mean; SD = standard deviation.

Mile run performance time. A paired-samples t-test revealed no difference between the 5-lap MRW versus 10-lap MRW completion times ($p > .05$). Additionally, a 2 (track configuration) by 5 (split times) repeated measures ANOVA revealed a significant interaction between mile split time and track configuration ($p < 0.05$). However, a posteriori t-tests with Bonferroni adjustment revealed no significant difference for Split1, Split2, Split3, and Split4 times between both track configurations. Interestingly, an a posteriori t-test revealed a fourteen second difference between times for Split5, but this difference was not statistically significant ($p > .05$). Average times by split are presented in Figure 2.

Perception of effort and perception of enjoyment. A paired-samples t-test revealed no significant difference between RPE scores ($p > .05$) from both MRW course configurations. Kendall's W Tests showed no significant differences in responses to either the "I ran my hardest" item ($p > .05$) or the "I enjoyed running today" item ($p > .05$) of the post-run questionnaire between the two course configurations. Means and standard deviations of measures for the experimental group are presented in Table 3.

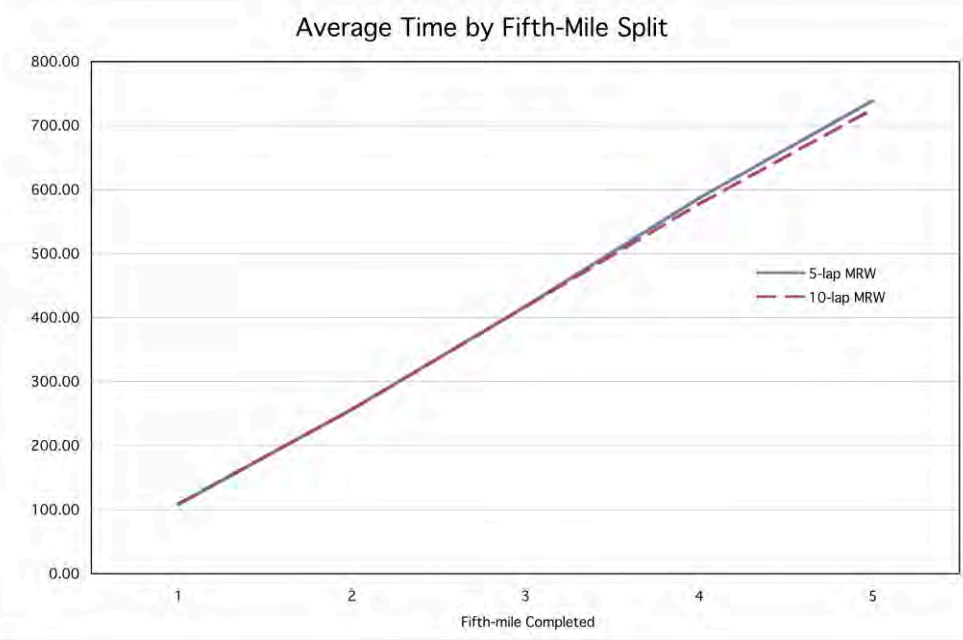

Figure 2. Average Time by Split During the Mile Run in 5-lap and 10-lap track configurations

Table 3

Means and Standard Deviations of MRW Results for Experimental Group (n = 77)

MRW Trial	MRW Time (sec)		RPE (1-10)		Hardness (1-5)		Enjoyment (1-5)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
5-lap	739.55	116.44	6.16	1.95	2.22	1.24	1.89	1.10
10-lap	725.74	103.32	6.10	2.19	2.06	0.99	1.96	1.02

Notes: M = mean; SD = standard deviation.

Discussion

The purpose of this study was to determine if varying the course configuration of the MRW test altered student perceptions and performance during the test. By manipulating the course configuration of the test, we examined if comparisons between the results of different MRW trials are valid across different course configurations. If students' performance does not vary with different MRW course configurations, broad comparisons between MRW trials (Beets & Pitetti, 2004) may be appropriate in assessing and studying cardiovascular fitness levels in youth.

As a measure of internal validity of the MRW trials, two control groups were used to assess the test-retest reliability of both track configurations. Consistent with results from other studies (Buono, et al., 1991; Rikli, et al., 1992), the MRW test was shown to be a reliable measurement on both track configurations from two trials. Even though the reliability of the 5-lap configuration (R = 0.91) was much higher than the reliability of the 10-lap configuration (R = 0.76), both were acceptable and in similar ranges to previously published data (Rikli, et al., 1992).

The purpose of this study was to examine how varying the course configuration of the MRW test affected student perception of the test and performance during the test. The first question addressed by this study was whether students prefer a smaller (10-lap) course or a larger (5-lap) course. The results showed a slight (56.8%) preference toward a larger MRW course configuration for the experimental group. This preference remained even after the students ran on

both MRW course configurations. This preference may indicate the students' desire to run fewer laps during the MRW test. As Sadalla and Magel (1980) showed, the number of right hand turns in a pathway positively influenced the perception of distance traveled. So, it is possible that this same phenomenon occurred within the students of this study. They may have perceived the ten laps to be a greater distance than the five laps, due to the increased number of turns. However, as students were told they would be running a mile during both MRW courses, the perceived distance traveled was not assessed in this study. Additional studies are needed to assess if altering the number of turns in a path leads to an altered perception of distance traveled, in youth.

The second question addressed by this study was whether altering the MRW course configuration influenced physical performance on the test. The results of this study suggest no difference in total time between 5-lap and 10-lap MRW trials. Even though there were no statistically significant differences between mean times for the two configurations, the 10-lap MRW times were lower by approximately 14 seconds. Interestingly, this difference in time did not become apparent until the last split time measurement. As seen in Figure 1, the pacing of the students for the first three split times was consistent between the two track configurations until the last two splits. Analysis by split times did indicate a significant difference ($p < .05$) between the last split times. This may indicate a change in the students' pacing as they fatigued during the trials.

One possible explanation for this increased pacing may be the students' perception of the finish being closer on the 10-lap configuration than the 5-lap configuration. As St. Clair Gibson et al. (2006) suggest, the knowledge of the endpoint in an exercise bout factors into the pace setting strategy of the individual —a concept called teleoanticipation. Throughout an exercise period, the pacing center in the brain monitors various inputs (environmental factors, heart rate, body temperature, speed, metabolic rate, etc.) to adjust the individual's pace to avoid failure of any physiological system prior to the completion of the activity. Students running around the 10-lap configuration passed cones more frequently, so they had more frequent environmental stimulus, which may have been used to increase the pacing at the end of the trial. Additional studies would be useful in understanding teleoanticipation during exercise bouts in children.

Another possible explanation for this increased pacing is the positioning of the adult observers in relation to the student runners. Because the 10-lap course is half the size of the 5-lap course, the students were in closer proximity to the adult observers for greater amounts of time. Therefore, as the students began to fatigue, the closer proximity of the adult observers may have provided increased motivation of the students to avoid walking and finish the mile run more quickly. This supports previous research (Patterson & van der Mars, 2008) showing a relation between observer proximity and physical activity levels.

The third question addressed by the study was whether perceived effort or enjoyment was influenced by changes to the MRW configuration. As a proxy of the perception of effort, RPE scores were used. With the greater number of turns associated with the 10-lap course, it was hypothesized that the 10-lap MRW would be perceived as longer than the 5-lap MRW (Sadalla & Magel, 1980) and perhaps lead to higher RPE scores. This hypothesis was not supported, as there was no difference in RPE scores. It is possible that the lack of RPE "landmarks" provided to the students while introducing the RPE scale lead to no differences. Utter et al. (2002) suggest giving the students "landmarks" of physical activities that the students are familiar with to corresponde to the various levels of RPE scores. This lack of familiarization with the use of this scale may explain the limited reliability of this measurement. However, results indicated that students generally agreed that they ran their hardest on both trials and that they enjoyed running on both courses. These results may support the finding that the RPE scores were not different between the course configurations. As the students' perception of running their hardest did not vary, one might expect the RPE scores to be similar between the two course configurations. Moreover, given that students completed the same amount of work, it is expected that their perception of effort did not differ between course configurations.

Hopple and Graham (1995) suggested that students may enjoy physical fitness testing if the tests are modified or changed. The results from this study did not support this claim, as student enjoyment was unaffected by modifying the course dimensions of the MRW test. Hopple and Graham (1995) also suggested that students generally do not enjoy fitness testing because they do not understand the purpose behind it. For the students in the current

study, one perceived benefit of the MRW test might have been to get out of class. As the students were brought out to the field in smaller groups, without the entire class present, they may have perceived a greater level of autonomy apart from the remainder of the class. Just being outside of the classroom might have been a reason enough to explain the high enjoyment scores on both course configurations. So it is unclear if our results conflict with Hopple and Graham's finding that students do not enjoy fitness testing.

Limitations

One limitation of the current study is that the schools were purposively chosen based on the availability of a large field to accommodate both track configurations. Additionally, the schools were chosen from a predominantly Hispanic community, so additional studies are needed to understand the generalizability to other populations. During the MRW trials, split times were measured using a novel time measurement tracking chart, which may have contributed to the decreased reliability of the 10-lap MRW configuration. Though the trials were administered at the same time on separate days, there may have been some variation between the students' readiness to perform the trials on different days. A standardized warm-up may have better prepared the students to run on both trials. Also, there were no landmarks given for the Children's OMNI scale as recommended by Robertson (2004), which may have decreased the reliability of this particular measurement.

Conclusion

The purpose of this study was to assess the effect of track configuration on perception and performance of elementary school students during the MRW test. The results suggest there is no difference in performance time across MRW course configurations. However, it is possible other factors (e.g., proximity of investigator to student, number of laps, being outside) may contribute to changes in times. Additional research is needed to further test these findings before more conclusive recommendations can be made. Contrary to Hopple and Graham (1995), the results of this study indicate that fifth grade students generally enjoyed the MRW, regardless of configuration. Modifying the track dimensions did not influence the student enjoyment of the MRW test in the present study. Future

research will have to be performed to better understand what modifications to fitness testing protocols lead to changes in student enjoyment.

References

Beets, M. W. & Pitteti, K. H. (2004). One-mile run/walk and body mass index of an ethnically diverse sample of youth. *Medicine and Science in Sports and Exercise, 36*, 1796-1803.

Buono, M. J., Roby, J. J., Micale, F. G., Sallis, J. F., & Shepard, W. E. (1991). Validity and reliability of predicting maximum oxygen uptake via field tests in children and adolescents. *Pediatric Exercise Science, 3*, 250-255.

Da Silva, J. A. (1983). Scales for measuring subjective distance in children and adults in a large open field. *The Journal of Psychology, 113*, 221-230.

Eisenmann, J. C., Welk, G. J., Ihmels, M., & Dollman, J. (2007). Fatness, fitness, and cardiovascular disease risk factors in children and adolescents. Medicine and *Science in Sports and Exercise, 39*, 1251-1256.

Hopple, C., & Graham, G. (1995). What children think, feel, and know about physical fitness testing. *Journal of Teaching in Physical Education, 14*, 408-417.

Mahar, M. T., Rowe, D. A., Parker, C. R., Mahar, F. J., Dawson, D. M., & Holt, J. E. (1997). Criterion-referenced and norm-referenced agreement between the mile run/walk and PACER. *Measurement in Physical Education and Exercise Science, 1*(4), 245-258.

Meredith, M. D., & Welk, G. J. (Eds.). (2007). *Fitnessgram/ Activitygram test administration manual.* Champaign, IL: Human Kinetics.

Patterson, D. L., & van der Mars, H. (2008). Distant interactions and their effects on children's physical activity levels. *Physical Education and Sport Pedagogy, 13*, 277-294.

Rikli, R. E., Petray, C., & Baumgartner, T. A. (1992). The reliability of distance run tests for children in grades K-4. *Research Quarterly for Exercise and Sport, 63*(3), 270-276.

Robertson, R. J. (2004). *Perceived exertion for practitioners.* Champaign, IL: Human Kinetics.

Robertson, R. J., Goss, F. L., Aaron, D. J., Tessmer, K. A., Gariola, A., Ghigiarelli, J. J., Kowallis, R. A., Thekkada, S., Liu, Y., Randall, C. B., & Weary, K. A. (2006). Observation of perceived exertion in children using the OMNI pictorial scale. *Medicine and Science in Sports and Exercise, 38*, 158-166.

Robertson, R. J., Goss, F. L., Boer, N. F., Peoples, J. A., Foreman, A. J., Dabayebeh, I. M., Millich, N. B., Balaskeran, M. G., Riechman, S. E., Gallagher, J. D., & Thompkins, T. (2000). Children's OMNI scale of perceived exertion: Mixed gender and race validation. *Medicine and Science in Sports and Exercise, 32*, 452-458.

Sadalla, E. K., & Magel, S. G. (1980). The perception of traversed distance. *Environment and Behavior, 12*, 65-79.

Safrit, M. J. (1990). The validity and reliability of fitness tests for children: A review. *Pediatric Exercise Science, 2*, 9-28.

St Clair Gibson, A., Lambert, E. V., Rauch, L. H. G., Tucker, R., Baden, D. A., Foster, C., & Noakes, T. D. (2006). The role of information processing between the brain and peripheral physiological systems in pacing and perception of effort. *Sports Medicine, 36*(8), 705-722.

Ulmer, H-V. (1996). Concept of an extracellular regulation of musclar metabolic rate during during heavy exercise in humans by psychophysiological feedback. Experentia, 52, 416-420.

Utter, A. C., Robertson, R. J., Nieman, D. C., & Kang, J. (2002). Children's OMNI scale of perceived exertion: walking/running evaluation. *Medicine and Science in Sports and Exercise, 34*, 139-144.

Xiang, P., Bruene, A., & McBride, R. E. (2004). Using achievement goal theory to assess an elementary physical education running program. *Journal of School Health, 74*, 220-225.

Xiang, P., McBride, R. E., & Bruene, A. (2004). Fourth graders' motivation in an elementary physical education running program. *The Elementary School Journal, 104*, 253-266.

Xiang, P., McBride, R. E., & Bruene, A. (2006). Fourth-grade students' motivational changes in an elementary physical education running program. *Research Quarterly for Exercise and Sport, 77*, 195-207.