Effect of Mental Training on the Performance of College Age Distance Runners

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***Abstract*-The purpose was to determine if Event Rehearsal Imagery (ERI) and Internal guided Imagery with Distractions (IGID) resulted in improvements in the running performance of college students. The participants (N = 74) were students at Kenyatta University in Nairobi, Kenya. Cooper's 12 min run test was used to assess running performance. Following 8-weeks of training, findings indicated that there was a statistically significant difference (0.05 level) in running performance between the Event Rehearsal Imagery (n = 29), Event Rehearsal Imagery with Distractions (n = 16) and the Control group (n = 29). Overall, there was a significant mean difference in running among male (n = 47) and female (n = 27) participants.**

Keywords- Kenya; Mental Training; Running; Cardiovascular Endurance

I. INTRODUCTION

Although Kenya is the running capital of the world, little attention has been given to the mental training of college age students. For the most part, the focus of mental training in Kenya and abroad has been on elite high school, college, Olympic and professional players. The truth of the matter is that mental training, which includes relaxation, concentration, imagery, goal setting, team building and cognitive restructuring, should be for everyone. According to Napersack [1], the health value of mental training has been clearly established. Her relaxation and visualization techniques have been used by persons who suffer from a wide variety of illnesses, including cancer, hypertension, anxiety, post-traumatic stress, depression and other illnesses. This investigation will add to the growing body of knowledge about the effects of distractions on running performance of college age students.

This review will cover two topics that are related to this investigation, i.e., the effect of mental training without distractions and the effect of mental training with distractions. First, we will present evidence for the effect of mental training (MT) on sport performance. Reviews of the literature on this topic were reported by: Richardson [2], and Feltz and Landers [3]. In another meta-analysis, Lander [4] answered a long-standing question in the sport psychology literature: Does a given amount of mental practice prior to performing a motor skill enhance one's subsequent performance? Of 60 investigations yielding 146 effect sizes, the overall average effect size was 0.48. Landers concluded that mentally practicing a motor skill influences performance somewhat better than no practice at all.

More recently, reviews of the literature were also completed by Driskell, Cooper and Moran, [5], Weinberg and Comar [6], and Behncke [7]. All of these investigators found support for the use of mental training. However, mental training must be practiced systematically over time to gain enhancement of performance in a wide variety of sports. Weinberg [8] identified two distinct motivations underlying the desire for an athlete to improve performance, they were, extrinsic rewards and intrinsic motivation. Weinberg [8], Martens [9] and Rushall [10] all suggest that athletes should be encouraged to improve performance from intrinsic rather than extrinsic motivation. Behncke [7] summarized well when he stated: "mental skills training relies on a methodology of self-mastery, generated through self-knowledge, to enhance the psychological state of the individual" (p. 2.).

Raglin [11] has proposed a Mental Health Model (MHM) that links performance in sport to psychopathology. He stated that there is an inverse relationship between sport performance and psychopathology, i.e., as mental health worsens or improves, performance should fall or rise accordingly. According to Raglin, there is considerable support for this view. Studies have shown that between 70% and 85% of successful and unsuccessful athletes can be identified using general psychological measures of personality structure and mood state.

After a thorough and exhaustive review of the research and conceptual literatures by Plessinger [12], she concluded that mental imagery should be combined with physical practice to produce the most favorable results. In addition, she stated that mental imagery not only improves specific motor skills but it also seems to enhance motivation, mental toughness and confidence. To summarize, after following several carefully conducted investigations, it seems clear that mental training when coupled with physical practice has the potential to enhance performance in a wide variety of sports.

There is growing research and popular interest in the role of distractions in the enhancement of cognitive and psychomotor tasks. Russell, et al. [13] compared a post-exercise mood enhancement program across common exercise distraction activities. These investigators examined whether exercise under conditions of distraction (television watching, reading) differed significantly from exercise control conditions. College students (N = 53) were randomly assigned to: exercise while reading, exercise while watching television or exercise control conditions. The POMS (Profile of Mood States Questionnaire) was used to assess pretest and posttest mood. Their findings indicate that it may be the enjoyable characteristics of distraction, and not distraction itself that are important in the exercise mood-enhancement relationship.

Other investigators, e. g., Spink [14] investigated the role of distractions in facilitating endurance performance. He randomly assigned individuals (N = 36) to one of three experimental groups: dissociation group, dissociation/analgesic group, and a control group. Measures of leg-holding times and subjective pain ratings were obtained twice, once before the treatment and once after the treatment. Results indicated that individuals in the dissociation/analgesic group performed significantly better on the posttest than individuals in the dissociation and control groups. De Bourdeadhuij, et al. [15] examined the effects of distractions on treadmill running time in severely obese children and adolescents (10 boys and 20 girls). Participants, ranging in age from 9 – 17 yrs., they resided in a treatment facility for 10 months. Participants performed a treadmill test until exhaustion in four different sessions. There were two sessions at the beginning and two sessions at the end of treatments. Treatments were counterbalanced, one with attentional distraction (music) and one without distraction. Obese youngsters ran significantly longer during distractions.

In a classic investigation, Pennebaker and Lightner [16] reported the results of two experiments with students. In a field experiment, they found that focusing attention on external stimuli while running led to faster running compared to the processing of internal stimuli while running. And in a treadmill study, participants were forced to process internal sensory information, such as their breathing rate, reported a large number of symptoms relative to participants who processed external sensory information (headphones with street noises) or no information (wearing headphones but hearing no sounds). They explained the beneficial effects of attentional distraction as contributing to a higher perception threshold for bodily information that normally inform participants to stop.

In a literature review covering the past 20 years, Masters and Ogles [17] confirmed that distractions have a positive effect on the motor performance of exercise and sports performance. More specifically, they reported that association relates to faster performance, dissociation relates to lower perceived exertion and possibly greater endurance. Further, they indicated that dissociation is not related to injury but association may be.

To summarize, the above investigations show that the use of distractions to enhance sport performance is worthy of further investigation. A reported above, some studies show positive gains while other do not. Further research is needed to clarify the distraction-performance relationship.

With the results of the above investigation in mind, the investigators decided to add to the growing body of knowledge about the effects of distractions on the running performance of Kenyatta University students (N = 74). It was hypothesized that students who experienced distractions while imaging running would perform significantly better than students who did not have distractions while imaging their running performance. In addition because of super muscular strength, it is hypothesized that male students will out-perform female students in running performance.

II. METHOD

A. Participants

Prior to data collection, ethical approval for this study was obtained from the members of the Department of Exercise and Sport Science at Kenyatta University. A convenient sample of participants (N = 74), ranging in age from 18 – 26 years, were selected from university students who were studying at Kenyatta University, Nairobi, Kenya. Since Kenyatta is a National University, participants were from the various geographical regions within the country. Based on availability, male (n = 47) and female (n = 27) students were chosen from various populations within Kenyatta University. Recruiting procedures produced approximately 30 participants from the general population, 30 students who have not been exposed to the subject area from the College of Exercise, Recreation and Sport Science, and 30 students from other departments within Kenyatta University. Students were recruited from the second to fourth class term.

B. Materials

Cooper’s 12 min walk run test was used to measure running performance. According to Cooper, the test has established validity and reliability. Generally a correlation of 0.65 or better was found for runs of greater than 9 minutes. Plastic cones were placed at intervals of 100 m around a measured 400 m grass tract. Seiko stop watches (SO56-B, Seiko, Tokyo) with 100 time splits were used to time participants. Announcement of times were provided a 4 m, 8 m and 10 m intervals and when one minute was remaining. Laps and segments of laps were counted by trained research assistants to assess the distance run by each participant.

C. Procedure

A pretest/posttest design was used to assess the effects of mental training on the middle distance running performance of Kenyatta University students (N = 74). According to Babbie [18], this classic controlled quasi experimental design is appropriate when investigators desire to test the effectiveness of independent variables on dependent variables. Experimental treatments (n = 3) were randomly assigned to groups (n = 3). Because of class scheduling conflicts, the participants (N = 74) were assigned to groups based on availability. Therefore, ANCOVA was used to adjust final posttest mean scores for between group differences in running performance that existed prior to the start of this experiment.

1) Pretest

Cooper's 12 min walk run test was used to assess running performance prior to the start of this investigation. Stop watches were used to time participants. It was explained to the groups that the intervals and specialized techniques were an antidote to constant one tempo running. Pacing strategies for increasing optimum energy while running has been defined as an issue by researchers using Cooper's test as an evaluative tool [24]). To accomplish the interval training pacing objectives, five different types of intervals were chosen to be run within and adjacent to the 400 m grass track. The researchers chose these interval distances because they represented a cross section of lengths that could be combined to achieve maximum physiological aerobic and anaerobic conditioning. They were: 80 m, 100 m, approximately 300 m, and two diagonals across the fields which were about 150 m. The complete length of the field, approximately 1000 m, was used to demonstrate the varied and increased pacing procedures used in the 24-Step Formula (Spino, [21].

2) Experimental Treatments

Following the initial assessment of running performance, each participant in the experimental groups received a 15 min. introductory lecture and explanation of the physical and mental training program. Internal, rather than external imagery, was chosen as the modality of chosen for this experiment. Gardner and Moore [19] suggest that internal imagery is more effective than external imagery.

The two experimental groups (Event Rehearsal Imagery and Event Rehearsal Imagery with Distractive Imagery) were taught the physiological principle of Exercise Heart Range (EHR) which was used in their interval running training program. It was explained as follows: "The Exercise heart Range is a theoretical but practical construct based on a maximum heart rate of 220 bpm. The target for workouts that enable attainment of maximum fitness is to subtract a person's age from 220 and aim for 65 to 85 percent of this number" (Spino [20], p. 85).

A number of other techniques and concepts for enhancing pacing and assisting with mental concentration were taught to members of the experimental groups. They were fresh swing tempo, tidal breathing, soft eyes, surging, acceleration point, and 24-step formula.

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3) Training Methodology

All experimental group members were taught the following techniques for improving the interval training, and strategic pacing. A five-point Likert scale was used to measure their effectiveness. The Control group did running at their own pace throughout the 8-wks experiment.

4) Workout Techniques

Workouts that are sections tied together with various segments are termed interval training. This means that the individual or group is moving at various intervals using a technique that corresponds to the desired cardiovascular workout. The following activities were used to train experimental group participants.

- *Fresh Swing Tempo* – A gait of running where participants move at about half speed, up to 50% effort. The purpose of the run is to increase the heart rate of participants at a low threshold of the Exercise Heart Range (EHR).
- *Good Swing Tempo* – A gait of movement that enables participants to enter the middle and higher location of the EHR.

- *Tidal Breath* – A technique of breathing that implements a full lung capacity enabling full acceleration into a faster gait of running.
- *Surging* – A technique of focusing while running by squeezing thumb to middle of first finger, making a 'ping' sound and accelerating into a faster tempo.
- *Acceleration Point Instruction* – The point at which a participant changes from one tempo to the next. To assist with this transition of pacing, participants used a surge or tidal breath.
- *Twenty*-Four Step *Formula* – A method of shifting pace (from light, to moderate to brisk) so that participants may utilize a wide variety of the EHR during each phase of the execution of each 24-steps.

5) Experimental Groups Mental Training Techniques

The following statements list and explain the techniques that were administered to members of the experimental groups. They enabled participants to integrate mental training techniques into their ongoing training program. At each venture, the goal was to be looking inward for a fresh perspective on the task ahead and to have an awareness of what is occurring within one's mind.

The objective of mental training was to introduce particular thought patterns into the participant's mental outlook. The present study utilized a number of mind/body techniques. The 'Soft Eyes' technique was adopted form the martial arts and was used to enable participants to be able to 'look within' at the same time as safely running forward. "Stand and close your eyes- we will now practice techniques for looking inward. Close your eyes and imagine a large bird flying across the sky. Look at the feathers on his wings as he flies; notice the smoothness of his movements as he dips into a valley and then flies over the top of the mountains. Now open your eyes slightly, so that you can look out while at the same time viewing inward to your mind's eye to watch the bird in flight, and view yourself with the same fluid motion as the bird. Now, ~~you will~~ wipe the image from your mind by moving your fingers across your eyelids. By wiping your eyelids, you will be condensing the time that you are using 'soft eyes' and improve your ability to use the technique to your advantage when combining it with your running. By wiping the imagery away, you have established a beginning and end of this session. "Make a mental note of what has transpired in your mind and create a basis for your memory and remembrance" (Spino [21], p. 139).

6) Guided Imagery with Distractions

Distractive imaging was an intervention conducted during guided imagery rehearsal for participants (n = 19) in the Distractive Imagery Group (DI). Four times during the Event Rehearsal of the 12 m run, participants were distracted from the script and asked to roll over onto one side and find, and mark by crossing off a random number from a tally sheet. The object of this exercise was not to cross-off a correct number but the overall distraction it caused. Distraction research findings are equivocal (Bharani, Matthews & Sadhu, [22]. Some investigators contend that distraction may cause a decrement in performance; others believe that it can have a positive influence according to the type of stimulus (Bharain, Matthew & Sadhu, [22]; Reisberg & O'Shaughnessy, [23]. Distraction exercises may also be used to slow down peak performance or to stabilize a team that is out of union with each other.

7) Posttest

To determine the effect of experimental treatments on the dependent variable, Cooper's 12 m walk/run test (Cooper, [24] was used to assess running performance. Plastic cones were placed at intervals of 100 m around a measured 400 m grass tract. Seiko stop watches (SO56-B, Seiko, Tokyo) with 100 time splits were used to time participants. Announcement of times were provided a 4 m, 8 m and 10 m intervals and when one minute was remaining. Laps and segments of laps were counted by trained research assistants to assess the distance run by each participant.

In addition to the evaluation of running performance, a questionnaire was used to determine the opinions of participants about the effectiveness of the training procedures. To determine the effect of mental training on running performance, the investigators' goal was to provide participants with a positive and satisfying mind/body experience while improving Max VO2 and running economy.

8) Statistical Treatment of Data

Analysis of Covariance (ANCOVA) was used to adjust final group mean distance running scores for initial mean differences that existed between the groups prior to the start of this experiment. A justification for using ANCOVA was to minimize the error variance associated with the use of class schedules rather than randomized groups. Data were collected at the beginning and at the end of this 8 - wks. experiment.

When significant F-ratios were found, Bonferroni's [25] procedures were used to locate between group differences. When using parametric statistical procedures, investigators should try and meet the basic assumptions of random sampling, normality, and homogeneity of variance. And, for multivariate experiments, there should be three times as many participants as variables (e.g., Keselman et al., [26].

Class scheduling prevented the investigators from fulfilling all of these basic assumptions. However, some statisticians (Box, [27]; Glass, et al. [28] have cogently stated that even if some of these assumptions are violated that these tests are rigorous enough to be used to analyse research data. From a contemporary perspective, Keselman, et al., [26] stated that "researchers rarely verify that validity assumptions are satisfied and they typically use analyses that are no-robust in assumptions to some degree" (p. 363).

Following tests for normality and homogeneity of variance of pretest and posttest scores, parametric statistical procedures were used to analyse the data. The Kolmogorov-Smirnov [29] procedures for normality indicated that pretest data were normally distributed among the three groups of participants. In addition, Levene's statistic for homogeneity of variance demonstrated that there was no significance difference ($F (2, 71) = 8.46$, $p < .001$) in the spread of scores away from their respective means among the three groups of athletes. Glass et al., [28] found that many parametric tests are not seriously affected by violation of assumptions.

Having met the assumptions for normality and homogeneity of variance underlying the use of parametric statistical procedures, descriptive and inferential statistics were used to analyse the data. All hypotheses were evaluated at the 0.05 level of significance. When between groups statistical differences were found, Bonferroni's post hoc comparisons were made. Since random assignment of participants to groups was not possible, the three groups of participants ($N = 74$) were not equal in running performance following the pretest. Therefore, ANCOVA was used to adjust final posttest scores for initial differences in mean running performance that existed between the groups prior to the start of the experiment.

In addition, data analyses revealed that there were three outlier scores that exceeded 800 m. Therefore, the scores for Participants #40, #41 and #72 were eliminated from the analyses. Participant #1 did not take the posttest and therefore his data were also eliminated. The final sample sizes were: Experimental Group #1 ($n = 29$), Experimental Group #2 ($n = 16$), Control Group ($n = 29$).

III. RESULTS

The major null hypothesis H0 stated that there would be no significant between group mean differences in sport running performance, as measured by Cooper's Walk/Run test; In other words, this hypothesis stated that there would be no significant difference in mean running performance among Experimental Group #1 ($n = 29$) (ERGI), Experimental Group #2 ($n = 16$) (DI) and Control Group participants ($n = 29$) who did Event Rehearsal Guided Imagery (ERGI), Distractive Imagery (DI) and the Control Group (CG) activities.

Fig. 1 shows the mean posttest running scores and their stand deviations for the three groups of participants. Multivariate ANCOVA procedures (Table 1) indicate that his hypothesis was untenable. Wilks' Lambda = 0.91, $F (94, 132) = 1.59$, $p < 0.05$, $\eta 2 = 0.045$ showed that there were significant between group mean differences in running performance.

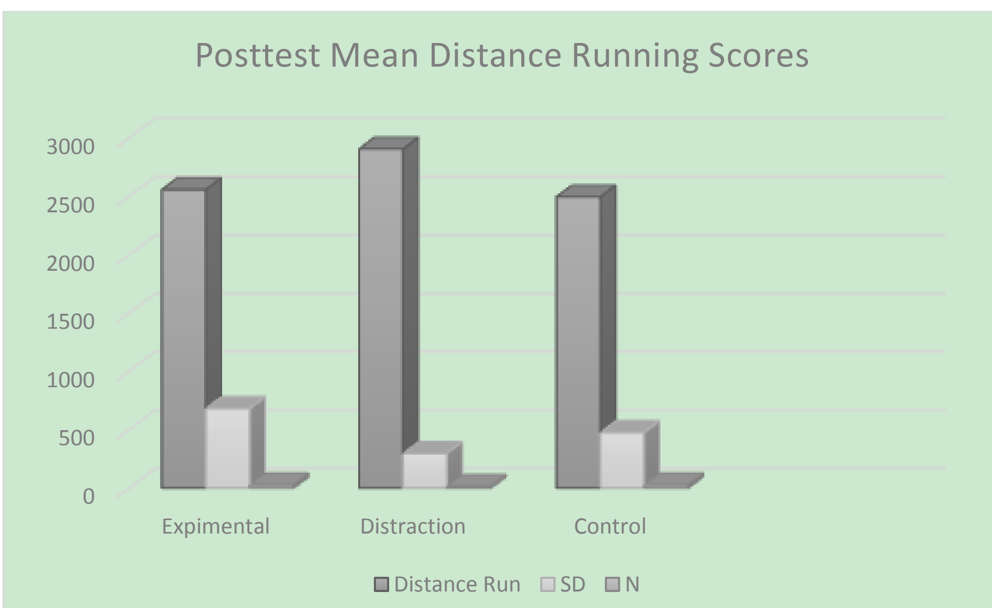

Fig.1. Posttest mean distance running scores (m)

TABLE 1 ANCOVA OF POSTTEST RUNNING SCORES FOR GROUPS, GENDER, AND GROUPS BY GENDER INTERACTION FOR KENYAN PARTICIPANTS

Source	SS	DF	MS	F	p	η^2
Groups	527124.10	2	263562.05	* 3.02	0.056	0.83
Gender	913457.08	1	913457.08	* 10.45	0.002	0.14
Groups x Gender	239073.43	2	119536.72	1.37	0.262	0.04
Error	5854664.81	67	87383.06			
Total	7534319.42	72				

HO1 stated that there would be no significant difference in mean running performance among participants who participated in Distractive Imagery exercises (DI) and those who did Event Rehearsal Guided Imagery (ERGI). This hypothesis was accepted. Bonferroni's pair-wise comparisons indicated that there was no statistically significant mean difference between Experimental Group #1 participants who did (ERGI) and Experimental Group #2 participants who did DI. Although there was a 202 meter mean difference between the two groups of guided imagery participants, this difference was not significant at the 0.05 level.

HO_3 stated that there would be no significant difference in mean running performance between participants who did Distractive Imagery exercises (n = 19) and participants who were in the Control Group (CG) (n = 22). This hypothesis was accepted. Bonferroni's post-hoc test indicated that the 132.99 meter difference between these groups was not statistically significant at the 0.05 level.

HO4 stated that there would be no significant difference in mean running performance between participants who did Event Rehearsal Guided imagery and Control Group participants. This hypothesis was rejected. Bonferroni's post-hoc test produced a statistically significant difference between these two groups of participants. The mean posttest running performance of participants (n = 19) in the Distraction visualization group showed the greatest improvement form the mean posttest running scores of Control Group participants (n = 22). The direction of the improvement for participants (n = 19) in the distractive group was over 400 m, i.e., a lap further on a 400 m track.

Overall it is concluded that the experimental treatments were effective in enhancing running performance, i.e., from pretest to posttest the mean running performance of the three groups of participants improved. However, despite the fact that Experimental Group #2 (Event Rehearsal Distractive Imagery) participants had the highest posttest mean score, Bonferroni's post-hoc comparison did not produce a statistically significant difference from Control Group participants.

Table 2 shows the means, standard deviations and F-values for demographic, physical and mental training variables. Participants rated each training procedure on a five-point Likert type scale with a five indicating very effective and a one indicating that the training procedures were ineffective.

TABLE 2 UNIVARIATE ANALYSIS OF DEMOGRAPHIC VARIABLES AND RESPONSES OF PARTICIPANTS ABOUT EFFECTIVENESS OF PHYSICAL TRAINING PROCEDURES

	Group							
	Experimental #1 (n = 39)		Experimental #2 (*n* = 19)		Control (n = 22)			
Variable	M	SD	M	SD	M	SD	F	p
Age	22.26	1.04	22.37	1.77	22.86	1.83	1.23	0.31
Yr. Study	2.83	0.76	2.21	1.32	2.64	1.05	2.41	0.97
Birth Order	2.15	1.39	2.74	1.28	2.45	1.68	1.08	0.35
Surge	3.82	1.23	3.47	0.90	3.18	0.91	2.54	0.09
Fresh Swing	3.92	0.98	4.16	1.17	3.41	0.59	3.52	0.03
Good Swing	4.36	1.06	4.05	1.31	3.68	0.65	3.03	0.05
24-Step	3.72	0.99	3.05	1.47	3.86	0.99	3.07	0.05
Acceleration Point	3.82	1.02	4.05	0.97	3.55	0.74	1.51	0.23

df = 2 & 77

The training techniques were explained to the Control Group members to allow them to participate in the evaluation. As shown, statistically significant between groups differences were found for Surge, Fresh Swing, Good Swing and Twenty-Four Step training procedures.

For the Fresh Swing Variable, Bonferroni's post-hoc test indicated that significant differences were found between Experimental Group- #2 (DI) and Control Group participants. As expected, Experimental Group #2 (DI) participants (n = 19) found the Fresh Swing technique more effective than Control Group participants who did not actively participate in this training procedure.

For the Good Swing variable, Bonferroni's post-hoc procedures produced significant (0.05 level) between-group differences between Experimental Group #2 (DI) and Control group participants. In addition, a significant difference (0.05 level) was not found for the Good Swing variable between Experimental Group #1 and Control Group students.

Despite a significant F-value (F = 3.07, $p < 0.05$) for the Twenty-Four Step procedure, post-hoc between-group comparisons did not reach statistical significance at the 0.05 level. No other Bonferroni post-hoc comparisons reached statistical significance at the 0.05 level.

Overall, [Wilks' Lambda = 0.59, F (20, 130) = 1.99, $p < 0.05$, η2 = 0.23] indicated that there were significant between-group differences in the evaluation of physical and mental training procedures. In addition, there was a significant overall mean difference among male and female participants [Wilks' Lambda = 0.07, F (10, 65) = 2.75, $p < 0.01$, η2 = 0.17]. However, using Bonferroni's procedures, only one of the 10 variables reached statistical significance at the 0.05 level.

A. Gender Comparisons

Fig. 2 shows the mean posttest running scores for male and female participants. On the average, Male participants (n = 47) performed more effectively than Female participants (n = 27) on Cooper's Run/Walk Test. Males had a mean distance score of 2,770.09 m (SD = 56.71) while Females produced a mean yardage score of 2,343.64 m (SD = 110.27). The univariate ANOVA [$F_{(1, 67)} = 10.24$, $\eta^2 = 0.14$] was statistically significant at the 0.01 level.

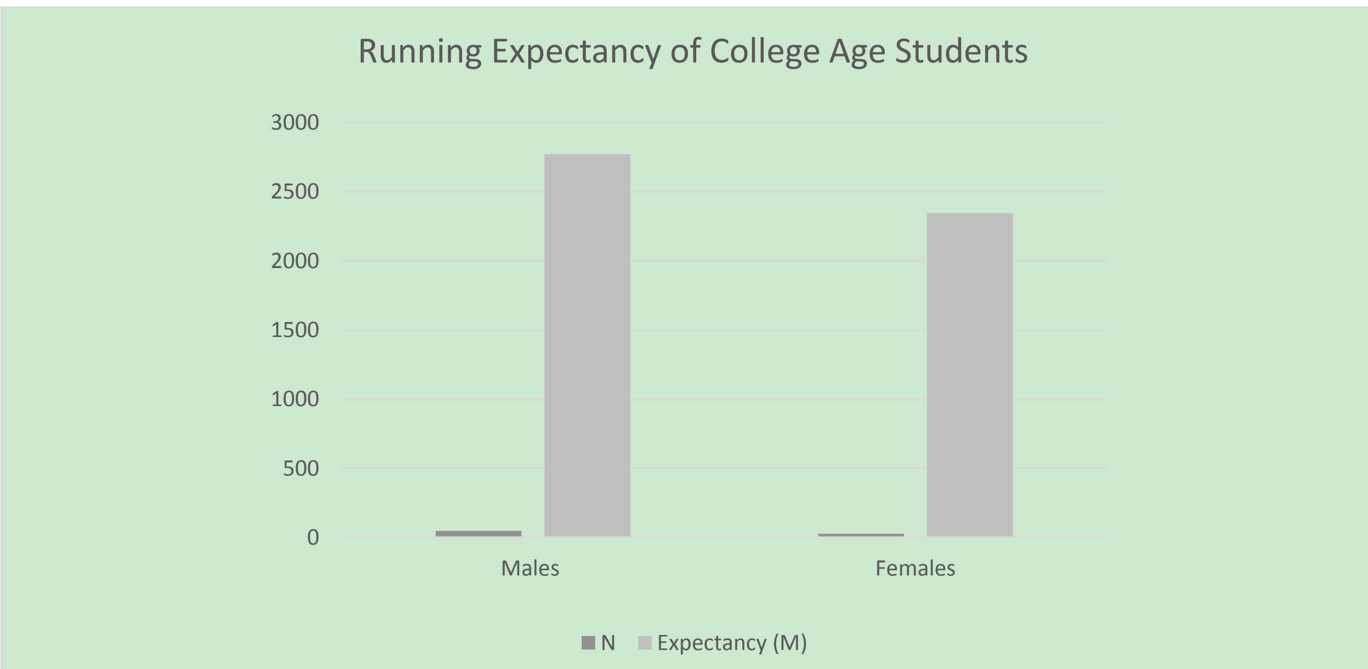

Fig. 2 Running expectancy distances (m) for male and female participants

The assessment of the interaction of Gender x Group was also significant [Wilks' Lambda = 0.69, $F_{(10, 65)} = 2.75$, $p < 0.01$, $\eta^2 = 0.17$]. However, using Bonferroni's procedures, only one of the 10 variables reaches statistical significance at the 0.05 level. Males, on average, were older than female participants.

IV. DISCUSSION

The findings of the present investigation are in agreement with the meta-analytic investigations of Feltz and Landers [3], Richardson [2], Wrisberg and Comar [6], and Driskell, et al., [5]. All of these investigators found that mental training when coupled with physical practice enhanced sport performance.

These findings are also in agreement with the work of Hall and Erffmeyer [30]. They found that visuomotor behavior rehearsal when used with videotape modelling enhance the performance of intercollegiate female basketball players. In a classic study, Mahoney and Avener [31] demonstrated that those gymnasts who did mental training made the US Olympic team more often than those athletes who did not do mental training. In summary, it is very clear that mental training when done well has the potential to enhance the performance of athletes in a wide variety of sports.

Since there are few investigations of the effects of mental training on ordinary students, it is unclear at this time if MT contributes to wellness. However, an important finding of the present investigation is that the participants really enjoyed and profited from the interventions that were used in this investigation. In support of the above finding, Mousavi and Meshkini [32] demonstrated that mental imagery reduced anxiety of tennis players, and improved their performance. The findings of the present investigation will add to the growing body of knowledge about MT's contribution to health and overall physical and psychological wellness.

Using college men and women as participants (N = 15), Straub [33] determined the effect of three different methods of MT on dart throwing performance. He found that Bennett and Pravitz [34], and Unestahl and Schill's, [35] procedures were effective in enhancing the dart throwing performance of these students. Despite receiving substantially less physical practice, students who practiced the MT procedures of the above investigators significantly enhanced their dart throwing performance.

Of course, a great deal more research is needed to clarify the role of distractions in the enhancement of motor performance. For example, what types of distractions work best? How often should distraction be applied during the application of mental training procedures? Do skilled athletes, versus less skilled athletes, react differently to the use of distractions when attempting to enhance their performances? As often happens, research most always generates more questions than it answers.

V. FUTURE RESEARCH

Despite extensive research during more than fifty years, there still remain many unanswered questions about the value of mental training and the effect of distractions on the performance of athletes. Although reviews of the literature by Feltz and Landers [3], Driskell [5], Weinberg and Comar [6], and more recently by Behncke [7] and Plessinger [11], show positive performance increments, some of these investigations they cite may be lacking in experimental rigor. Using different experimental procedures and tests that are sometimes lacking in validity, some of the above investigations are of little value. And although the use of meta-analysis is popular, some authorities indicate that it is like mixing apples and pears [36]. Walker, et al. indicated that meta-analysis is powerful but also controversial – controversial because several conditions are critical to a sound meta-analysis, and small violations of those conditions can lead to misleading results.

What is needed is to do investigations where experimental methods are careful monitored and treatments are extended over an entire season. The use of placebos groups are of course important and researchers need to use large sample sizes so that effect size is increased.

It is also unclear about what kind of distractions result in performance gains. In the present investigation a cross out sheet intervention was used to distract participants while they were visualizing their running performances. What would be a more viable procedure would be to audio and videotape distractions in the actual sport environment and see if these distractions affect sport performance. So to summarize, there is a dire need to carefully conduct investigations to determine the effect of distractions on the performances of athletes.

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