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The effect of physical fitness training on academic performance : a thesis ...

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THE EFFECT OF PHYSICAL FITNESS TRAINING ON ACADEMIC PERFORMANCE

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Abstract

In elderly psychiatric individuals, physical fitness training has been related to improved cognitive performance on several scales (Powell, 1974; Stamford, Hambacher, & Fallica, 1974). The results with normal adults and children, however, are not clear (Folkins & Sime, 1981).

The purpose of the present study was to test the effects of cardiovascular fitness training on cognitive functioning, relevant to academic performance, in college students. The following measures were used: Shipley-Institute of Living Scale, Rotter's Internal-External Control of Reinforcement Scale, a Student Learning Styles Questionnaire, self-report data indicating hours spent studying, quality of studies, and mental alertness during daily activities, and a bicycle ergometer test to determine physical fitness levels. It was predicted that a relationship exists between physical fitness training and these variables that presumably affect academic performance.

A physical fitness training effect was not found for the experimental group, which indicates that the experimental manipulation of the independent variable was not complete. Thus, no research hypothese could be supported. Suggestions for future research are discussed.

The physiological benefits of physical exercise have been well documented (Kasch, 1976; Padone, Lewis, Lonigan, & Goldstein, 1976; Ryan & Allman, 1974) and have contributed to the popularity of exercise in recent years. Less is known, however, about the effect of physical exercise and cardiovascular conditioning on cognitive functioning. Two aspects of this relationship will be discussed: the immediate effects of exercise on cognition, and the effects of regular exercise over a period of time, or physical fitness training.

Several researchers (Burgess & Hokanson, 1964; Davey, 1973a, 1973b; Lybrand, Andrews & Ross, 1954) have found that performance on certain mental tasks is facilitated by prior exercise. Burgess and Hokanson (1964) found that following very mild exercise, performance on a digit-symbol substitution task was improved and, as the duration of the exercise increased, performance on the task decreased. Similar results were reported by Davey (1973a), whose subjects pedaled a bicycle ergometer for varying periods of time and were tested after different amounts of physical exertion. A submaximal amount of physical exertion improved mental performance on Brown and Poulton's test of attention (which relies heavily on short-term memory), while longer periods of exertion decreased performance on the test. In another study by Davey (1973b) the duration of exercise

prior to an addition task was varied. An exercise duration of two to five minutes resulted in optimum performance on the addition task. Lybrand et al. (1954) found that prior rigorous exercise facilitates performance on manipulative problem-solving and perceptual organization tasks.

Others have found no change or a decrease in performance on mental tasks following exercise. Flynn (1972) reported that prior exercise on a bicycle ergometer and aerobic capacity were not significantly related to accuracy or speed on a test of addition and subtraction in adolescent boys. Gutin and DiGennero (1968a) reported diminished performance on an addition task following an exhaustive treadmill run. In another study, Gutin and DiGennero (1968b) used a one and five-minute step-up exercise; performance of simple addition immediately after the exercise was not significantly affected for 32 males. McAdam and Wang (1967) found that mild run-jog-walk exercise had no significant effect on a symbol-substitution task.

According to McGlynn, Laughlin, and Bender (1977), one of the problems with the above studies is that the physical work loads were not individualized; all people were given the same exercise work load regardless of each individual's cardiovascular fitness. The studies also vary in the intensity and duration of exercise, and

although several of the studies assumed cognitive performance on numerical tasks, cognitive measures vary as well (Gutin, 1973). The relationship between mental performance and prior exercise, therefore, seems unclear.

Other research has focused on the effects of regular exercise over a period of time, or physical fitness training, rather than the immediate effects of one exercise session. Young (1979) tested male and female adults on the Wechsler Adult Intelligence Scale (WAIS), Trail-Making Test, Crossing-Off Test, and Wechsler Memory Scale subtests before and after a cardiovascular fitness training period, and scores on the tests significantly improved over time. The study, however, did not include a control group. Merzbacher (1979) reported an improvement in WAIS subtest scores after a monthly diet and exercise regimen in aged patients, but this study also had no control group. Barry, Steinmetz, Page, & Rodahl (1966) tested eight elderly men and women before and after a physical fitness training program on short term retention, simple addition, and Raven's Progressive Matrices. No training effect was noted in this study.

In elderly psychiatric patients, exercise programs have been related to improved cognitive performance. Powell (1974) reported improvement on the Wechsler Memory Scale, Raven's Progressive Matrices, and Memory-for-Designs

test after 12 weeks of exercise, one hour per day for five days a week. No change was reported on several geriatric behavioral scales in this study, and no physical fitness effect was demonstrated. Stamford, Hambacher, & Fallica, (1974) reported some improvement on the WAIS in nine elderly psychiatric males, after twelve weeks of daily exercise. Significant changes in cardiovascular fitness were also demonstrated in this study.

In a review paper, Harris (1973) concluded that there are no well-controlled studies to support a relationship between motor and intellectual performance. Studies reviewed included those investigating academic achievement and physical fitness in children. Ismail and Gruber (1967) conducted studies with fifth and sixth-grade boys and girls using 42 motor and intellectual variables. Performance on coordination skills was found to be significantly and positively related to intelligence and academic achievement. However, the directions for the coordination items on the skills test may have been too complex for the less endowed intellectually, resulting in poor performance (Harris, 1973). In another study (Ismail, 1967), an experimental group of fifth and sixth-graders received physical education instruction three times a week for one year, while a control group received a daily recess period. Ismail found no significant differences between

group means on the Otis IQ Scale, but did find significant differences between group means on the Stanford Academic Achievement Test. However, the results of Ismail's study are inconclusive in isolating the effect of exercise on cognitive performance, because the experimental group may have received more attention and rewards for following instructions appropriately, compared to an independent recess activity control group. McGill and Ash (1979) classified children in the first through fifth grade as either participants or non-participants in organized youth sports programs. Scores on school-administered Science Research Associates (SRA) tests of reading, mathematics, and language arts were examined for each group. The participant and non-participant groups were not significantly different on these tests. O'Conner (1969) did not find any differences in academic achievement for first-graders randomly assigned to a Kephart motor skills program or a regular classroom physical education program that used minimal physical activity. Although the O'Conner study included an assessment of fitness changes, the fitness training was not cardiovascularly oriented.

Much research has focused on the effect of athletic participation on academic performance in high school and college students. After surveying the literature, Shaw and Cordts (1960) found conflicting and inconclusive results.

"There are just about as many authors who conclude that athletes are academically superior to nonathletes, as there are who believe there is no difference, or that nonathletes are superior" (Shaw & Cordts, 1960, p. 620). Bend (1968) investigated 14,000 students who were seniors between 1960 and 1965. A slightly higher percentage of athletes reported overall high school averages of "B+" or better (47%) than the percentage for the nonathletes (41%). Also, in the same sample, a slightly lower proportion of athletes had overall averages lower than "C", compared to nonathletes. In a study by Lueptow and Kayser (1973), the overall high school averages were calculated for 1750 seniors from 20 high schools. Fifty percent of the athletes were above the mean performance levels, as compared to 39% of the nonathletes. However, Rehberg and Schafer (1968), used rank in the graduating class as an index of performance and found no significant differences among athletes and nonathletes in their sample of 785 seniors from six high schools. Spreitzer and Pugh (1973) found no association between sport participation and cumulative grade averages of high school students. Finally, in a longitudinal study of a national sample of over 4,000, Hanks and Eckland (1976) concluded that no relationship could be found between participation in high school athletic programs and grades. This is similar

to the conclusion reached by Folkins and Sime (1981), who noted that the effect of physical fitness training on academic achievement is still unclear.

The above review suggests that cognitive performance may be improved by physical fitness training in elderly psychiatric patients. The relationship between activity and cognitive functioning in normal adults and children, however, is not clear. Aside from conflicting evidence in several studies, some of the studies had design problems, or failed to document physical fitness effects. The literature concerning athletic participation and academic performance is especially questionable for two reasons. First, these studies are correlational in nature, and participation in athletics is an attitude value which is not under experimental control. Also, grade point averages (the dependent variable in most of the studies) can be influenced by a number of extraneous factors.

The purpose of the present study was to assess the effects of cardiovascular fitness training on variables related to academic performance in college students. Cognitive ability and certain aspects of cognitive response style were studied. To some degree, the measures used in the present study reflected certain changes in life-style (e.g. hours spent studying, internal vs. external locus of control, etc.) that may be relevant to college-level academic performance.

A summary of the research hypotheses is provided in Table I. Jensen (1980) has noted "IQ alone predicts scholastic performance better than any other single variable or combination of variables that psychologists can measure" (p. 163). Hypothesis #1 is that IQ scores, as measured by the Shipley-Institute of Living Scale (Boyle, 1967), will improve as a function of physical fitness training. Although the WAIS is a more common measure of IQ, correlations of .78 to .90 have been reported between the WAIS and the Shipley Scale (Paulson & Lin, 1970; Sines, 1958; Sines & Simmons, 1959; Stone & Ramer, 1965; Wahler & Watson, 1962; Watson & Klett, 1965). The Shipley was preferred over the WAIS in this study because it is easily administered to large groups. This hypothesis was based on the findings of Young (1979), Metzbacher (1979), and Stamford et al. (1974), all of whom noted improvement in WAIS scores with physical fitness training.

Hypothesis #2 is that the experimental group will show an incresed perception of reinforcement being contingent upon their own behavior, rather than upon chance or upon another individual's control. These beliefs will be assessed with Rotter's (1966) Internal-External Control of Reinforcemnt Scale (I-E Scale). Perceptions of internal control have been shown to correlate with indices of striving for achievement relevant to academic performance

TABLE 1: Research Hypotheses

Measure	Hypothesis Number	Hypothesis
Shipley-Institute of Living Scale	1	The experimental group will show significant improvements on the Vocabulary Score, the Abstraction Score, the Total Score, and the predicted WAIS Score, while the control group's scores will remain the same.
Internal-External Control of Reinforcement Scale	2	The experimental group will show significant decreases on the I-E Score, while the control group's scores will remain the same.
Learning Styles Questionnaire	3	Subjects in the experimental group will have significantly higher scores on the Independent and Participant categories than the control group on the posttest of this measure.
	4	Subjects in the experimental group will have significantly lower scores on the Dependent and Avoidant categories than the control group on the posttest of this measure.
Daily Activity Log	5-12	Subjects in the experimental group will report (H. 5) more hours spent studying, (H. 6) less hours spent sleeping, (H. 7) higher quality of sleep, (H. 8) better performance at work, (H. 9) higher quality of study time, (H. 10) more alertness during classes, (H. 11) greater energy on a daily basis, and (H. 12) better thinking efficiency than the control group over 11 weeks of record keeping.
Physical Fitness	13	Subjects in the experimental group will improve significantly on the physical fitness measures, while the control group will remain the same.

(Efran, 1963; Franklin, 1963). This hypothesis was based partially on research (Jeffers, 1977) involving 200 male and female college students who participated in physical fitness conditioning classes. A significant change towards internal perception of control occurred after conditioning for both males and females. In females, although scores indicated greater perception of internal control than at pretest, they were not significantly different from the posttest scores of a control group, as they were for males. However, Gilliland (1974) noted no differences between males and females on the Rotter measure after administering the scale to 90 intercollegiate athletes and nonathletes. The prediction in the present study was that students would shift their perception of reinforcement control from external to internal with exercise, as they learned that physical fitness changes could occur through their own exercise actions.

Hypotheses #3 and #4 refer to student's styles of learning, as assessed by a Student Learning Styles Questionnaire (Berquist & Noonan, 1975, p. 33-37). The questionnaire identifies six learning styles that a student may acquire: 1) Competitive, 2) Dependent, 3) Participant, 4) Collaborative, 5) Avoidant, and 6) Independent. (See Appendix B for descriptions of these roles). Learning styles reflect forms of discipline that may be correlated with academic achievement. Since physical fitness training may also

be conceptualized as a disciplinary procedure, a student's style may be modified by physical fitness training. This measure has been previously used as a classroom tool to allow students to determine their generally preferred style of learning. To this author's knowledge, it has not been used as a measure in research prior to this study. Thus, Hypotheses #3 and #4 are speculative, but based on the assumption that independence and participation are encouraged and rewarded in a physical fitness training program, where dependent and avoidant behaviors are not.

Hypotheses #5-#12 refer to a self-report measure (Daily Activity Log) which provides information on students' daily patterns of living, including hours spent sleeping, hours spent in studies and class preparation, quality of sleep, quality of studies and class preparation, and mental alertness during classes, work, and studies. The current literature abounds with elaborations on the effect of exercise on mental acuity and energy level (e.g., Kostrubala, 1976; or Ullyot, 1976). Unfortunately, most of these reports are based upon the personal insights of runner-authors, and "although such speculations are intuitively appealing and are based upon years of personal experience, such insights cannot be generalized to runners at large" (Carmack & Martens, 1979, p. 25). Because of the lack of other research, however, Hypotheses #5-#12

are based upon the notions of the popular literature.

Hypothesis #13 refers to the physical fitness changes expected for the experimental group. This hypothesis is based on the well-known benefits of physical fitness training (e.g. Miller & Allen, 1979; Padone, Lewis, Lonigan, & Goldstein, 1976; Ryan & Allman, 1974). From heart rate during exercise, an individual's maximum oxygen uptake during exercise can be calculated.

> Under normal conditions of health and at normal atmospheric pressure, blood is about 98% saturated with oxygen when it leaves the lung. In a resting subject, about 30% of this oxygen is removed at the cellular level, but, during heavy exercise, this value can be increased almost three times. The amount of oxygen extracted from circulating blood in one minute is termed oxygen uptake. If measured during maximal exercise, this quantity is maximum oxygen uptake, which is believed by exercise physiologists to be the best single indicator of physical fitness, because it represents the ability of the body to mobilize all its systems during physical stress (Miller & Allen, 1979, p. 124).

For the experimental group, resting heart rate and blood pressure were likely to decrease, and maximum oxygen uptake was expected to increase. For most

participants, percentage body fat and weight were also expected to decrease with exercise.

Method

Subjects and Settigns

Participants were 60 male and female college students enrolled in two college level courses at University of the Pacific in Stockton, California. Students from a class entitled, "Heart, Exercise and Nutrition" made up the experimental group, and students from "Anatomy and Physiology" served as controls. Since the treatment involved physical fitness training, students participating in intercollegiate athletics prior to the study were not included in the data analysis. Of 69 students in the experimental class, 16 were on athletic teams, and 24 students either did not participate in the treatment, dropped the course, or did not attend either class or make-up sessions when pretest or posttest measures were administered. These students were excluded in the final data analysis, leaving 30 students in the experimental group. Of 54 students in the class used as a control, 10 students were on athletic teams, and 14 students either dropped the course or did not attend either the pretest or posttest sessions. These students were also excluded from the control group. In the final experimental group, 30% were males, and 70% were females. In the final control

group, 3% (1 student) was male, and 97% were females. The mean age for the experimental group was 20.7 years, and for the control group, the breakdown of subjects by year in school was as follows: Freshman, 30%; Sophomores, 23%; Juniors, 30%; Seniors, 6%; and Graduate students, 10%. In the control group, Freshman made up 3% of the group; Sophomores, 27%; Juniors, 53%; and Seniors, 17%.

The setting for the classes was in classrooms, with practicum lab periods for the Anatomy and Physiology class and exercise lab periods for the Heart, Exercise and Nutrition class. Some exercise periods for the experimental group were conducted in the University's swimming pool, and jogging sessions occurred in the local neighborhood.

Procedure

The Heart, Exercise and Nutrition class consisted of three lecture periods and two exercise periods per week, and students were expected to exercise outside of class. The control group attended the Anatomy and Physiology class an equal number of hours per week. Some academic content of the two classes overlapped, but the control group was not required to engage in physical fitness training.

Participants were told that a study was being conducted investigating the relationship between academic performance and physical fitness training. The daily log was carefully

explained, and the importance of keeping accurate regular records was stressed. All participants kept daily logs beginning the second week of the study, for 11 weeks. In both classes, point systems were used for grading students' participation and performance. In each group, students could earn points by completing the logs on a weekly basis.

All measures (except the daily logs) were administered to students in both groups during the first 2 weeks of the study, and after 11 weeks of the study (two weeks before final exams). Except for the physical fitness testing, all measures were administered to the participants in groups.

Students in the experimental group contracted for physical fitness plans of varying intensities, as measured by "Cooper points" (Cooper, 1977) (See Table 2 for a sample of Cooper point distributions). All subjects in the experimental group earned at least 30 Cooper points per week, a minimum necessary for good cardiovascular fitness, as defined by Cooper (1977). Eighty percent of the Cooper points earned each week by the experimental group were verified by exercise leaders. Participants in both groups recorded daily exercise activity using Cooper points, but exercise was not required for the control group.

TABLE 2: A sample of Cooper Points (Cooper, 1977).

THE POINT SYSTEM

WALKING/RUNNING

TIME (min:sec)	POINT VALUE
1.0 Mile	
over 20:01	0
20:00-15:01	1.0
15:00-12:01	2.0
12:00-10:01	3.0
10:00- 8:01	4.0
8:00- 6:41	5.0
6:40- 5:44	6.0
under 5:43	7.0
1.5 Miles	
over 45:01	0
45:00-30:01	0.5
30:00-22:31	2.0
22:30-18:01	3.5
18:00-15:01	5.0
15:00-12:01	6.5
12:00-10:01	8.0
10:00- 8:35	9.5
under 8:34	11.0

TIME (min:sec)	POINT VALUE
2.0 Miles	
over 40:01	1.0
40:00-30:01	3.0
30:00-24:01	5.0
24:00-20:01	7.0
20:00-16:01	9.0
16:00-13:21	11.0
13:20-11:27	13.0
under 10:52	15.0
2.5 Miles	
over 50:01	1.5
50:00-37:31	4.0
37:30-30:01	6.5
30:00-25:01	9.0
25:00-20:01	11.5
20:00-16:41	14.0
16:40-14:19	16.5
under 14:17	19.0

Measures

A summary of the measures used in the study is provided in Table 3. All measures were administered to both the experimental and control group.

In order to determine physical fitness, several measures were administered individually for each participant. Percentage body fat was calculated by using a skinfold caliper at four body sites: triceps, biceps, illiac crest, and subscapula. Height and weight were also measured. The student's resting heart rate while standing was taken manually for one minute, and the student then engaged in a short "step test", which required stepping up and down from a chair for one minute to the beat of a metronome. After a one minute recovery period, heart rate was again taken while the student stands. The difference between the two heart rates gave the experimenter a very rough estimate of the student's fitness, which was used as the basis for setting the workload for the bicycle ergometer test. The individual was then seated on the stationary bicycle, and resting blood pressure and resting heart rate was obtained. Heart rate was measured by an electro-cardiograph, attached to the person with electrodes. After the workload was set on the bicycle, the student pedaled to the beat of a metronome. Heart rate and blood pressure were monitored every minute until three consecutive

TABLE 3: MEASURES

MEASURE	FREQUENCY OF ADMINISTRATION	NUMBER OF SCORES	LIST OF SUB-MEASURES OR SCORES FROM MEASURE
Shipley-Institute of Living Scale	Twice: Pre & Post	4	Abstraction Age, Vocabulary Age, Total Score, Predicted WAIS from Total Score.
Internal-External Control of Reinforcement Scale	Twice: Pre & Post	1	I-E Score
Learning Styles Questionnaire	Twice: Pre & Post	6	Independent Score, Dependent Score, Collaborative Score, Avoidant Score, Competitive Score, Participant Score.
Daily Activity Log	5 days weekly for 11 weeks	9	Hours spent studying, Hours spent sleeping, Sleep quality, Performance at work, Quality of study time, Alertness during classes, Energy Level for day, Thinking Efficiency for day, Weekly Cooper Points.
Physical Fitness	Twice: Pre & Post	6	Weight, Percent Body Fat, Resting Heart Rate Resting Blood Pressure, Ml. of Oxygen consumed per minute for g/kg weight, Fitness Category.

heart rate readings were within 1 beat of each other ("Steady State" heart rate). After a steady state is achieved, the person stopped pedaling but remained on the bicycle while recovery heart rate and blood pressure were monitored each minute for 5 minutes. From this data, oxygen uptake during exercise was calculated. (Due to calibration adjustments on the stationary bicycle, steady state and recovery heart rate and blood pressure were not included in the data analysis). The pretest and posttest were identical for these measures, except in the posttest the heart rate was monitored manually in the interest of saving time.

The daily activity log (Appendix A) was filled out by the student each weekday and was collected weekly, except for week #10, which coincided with Thanksgiving vacation.

Rotter's I-E Scale (1966) was administered as a pretest and posttest. This scale, with instructions, is in Appendix D.

The Student Learning Styles Questionnaire was also administered. The general test form was given as a pretest and posttest (See Appendix B).

The Shipley-Institute of Living Scale consists of a vocabulary test and an abstraction test (Appendix C). Students were allowed 10 minutes on each part of the test.

The Shipley was also used as a pretest and posttest.

Design and Data Analysis

This study involves the use of a Nonequivalent-Control Group Design (Campbell & Stanley, 1963, p. 47) in which the subjects are self-selected. The implications of using this design will be reviewed in the Discussion section.

Split-plot Analyses (Two-Factor Mixed Design) was conducted individually for each sub-score of each measure: Shipley-Institute of Living Scale, I-E Scale, Learning Styles Questionnaire, Daily Logs, and the Physical Fitness tests. Missing data was treated as recommended by the Statistical Package for the Social Sciences manual (Nie, Hull, Jenkins, Steinbrennen, & Bent, 1975, pg. 57). Tables 4 and 5 illustrate the format that was used, with the Between Groups factor as "A" (Experimental and Control Groups), and the Within Groups factor as "B" (Pretest and Posttest in Table 4, and, for the Daily Log variables, Weeks 1-9, and 11, illustrated in Table 5). A group X test interaction was the predicted statistical test effect for each variable.

Results

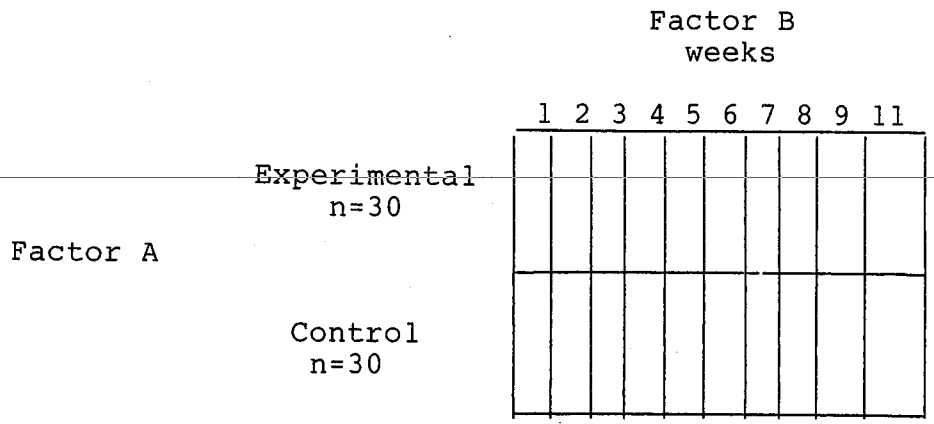
Table 6 shows the *F* values for the physical fitness measures, the Shipley Scale, the Learning Styles Questionnaire, and the Daily Activity Log. For the physical fitness, the following measures showed a significant group main

Table 4: Split-Plot Analysis for the Prestest-Posttest Measures

		Factor B: Pretest	Factor B: Posttest
Factor A	Experimental n=30		
	Control n=30		

Source	df
Between Subjects	59
Groups (A)	1
Subjects within groups	58
Within-Subjects	60
Trials (B)	1
AxB	1
Bx subjects within groups	58

Table 5: Split-Plot Analysis for measures of the Daily Activity Log.



Source	df
Between Subjects	59
Groups (A)	1
Subjects within groups	58
Within Subjects	540
Weeks (B)	9
AxB	9
B x subjects within groups	522

effect: the control group was significantly higher in body fat (F=25.17, df 1/50, $p < .01$) and resting heart rate (F=5.496, df 1/54, $p < .05$), while the experimental group had greater oxygen uptake (F=21.116, df 1/51, $p < .01$) and fitness category scores (F=7.797, df 1/51, $p < .01$). A significant sex main effect was found for weight, with males being heavier (F=27.71, df 1/54, $p < .01$), females having more body fat (F=89.07, df 1/50, $p < .01$), males having higher resting systolic blood pressure (F=22.458, df 1/54, $p < .01$), and greater oxygen uptake (F=5.287, df 1/51, $p < .05$). A pretest-posttest main effect was found for resting systolic blood pressure (F=5.156, df 1/54, $p < .05$). No other significant effects were found for the physical measures.

In the four sub-measures of the Shipley, the Abstraction test showed a significant group main effect (F=5.156, df 1/58, $p < .05$), and Vocabulary, Total Score, and WAIS Scores revealed significant pretest-posttest main effects (F=28.04, 19.428, and 20.404 respectively, df 1/58, $p < .01$). No other significant effects were found for this test.

For the Learning Styles data, the Avoidant Style measure yielded a significant test main effect (F=11.731, df 1/58, $p < .05$). No other significant effects were found for this measure.

The Daily Log data showed three significant effects: main effects across weeks for hours spent studying (F=2.194,

df 9/463, $p < .05$), for thinking efficiency (F=1.886, df 9/463, $p < .05$) and for sleep quality (F=1.968, df 9/463, $p < .05$).

Insufficient data for the control group prevented making a split-plot analysis on the Cooper point data.

No significant differences between groups or tests were found on the I-E Scale by inspection (Control Pretest Mean = 10.233, S.D. = 3.931, Posttest Mean = 10.333, S.D. = 4.00; Experimental Pretest Mean = 4.53, S.D. = 3.922, Posttest Mean = 9.9, S.D. = 4.24). A t-test was conducted on the absolute value of the difference between pretest and posttest scores ("change scores") for each group, and the experimental group had significantly higher change scores than the control group (t=2.54, df 58, $p < .05$).

Discussion

As the results show, no significant Group X Test interaction effect was found on any of the physical fitness variables. A closer look at the data reveals that of the 30 people in the experimental group, 13 improved in oxygen uptake, while the remainder stayed the same or became worse.

Since participation in a weekly exercise regimen of 30 Cooper points has been shown to improve oxygen uptake (Cooper, 1977) the treatment for this study was probably not complete. Cooper point data is lacking for the control

Table 6: F Values from Split-Plot Analyses

Measures	Group Main Effect	Sex Main Effect	Test Main Effect	Group x Test Interaction
Physical				
Weight	1.313	27.71**	1.517	.165
Body Fat	25.17**	89.07**	.004	.016
Resting Systolic Blood Pressure	4.023	22.458**	5.156*	2.134
Resting Diastolic Blood Pressure	2.798	3.649	3.590	3.247
Resting Heart Rate	5.496*	2.365	.698	.110
Oxygen Uptake	21.116**	5.287*	.067	2.638
Fitness Category	7.797**	.642	.002	1.467
Shipley				
Abstraction	4.826*		.587	.767
Vocabulary	.403		28.040**	.013
Total	2.899		19.428**	.326
WAIS	3.640		20.404**	.261
Learning Styles				
Independent	1.165		.295	.295
Avoidant	.655		11.731**	.457
Collaborative	2.913		.322	1.962
Dependent	.222		1.476	2.565
Competitive	.005		.272	.225
Participative	.312		.402	.003
	Group Main Effect		**Week Main Effect**	**Group x Week Interaction**
Daily Log				
Hours of Study	3.158		2.194*	1.005
Hours of Sleep	.055		.669	.501
Sleep Quality	1.754		1.968*	.821
Performance at Work	1.865		.272	.333
Quality of Study	.002		1.136	1.159
Alertness during Classes	.700		1.73	1.67
Energy Level	.259		1.391	1.494
Thinking Efficiency	1.147		1.886*	1.756

* $p < .05$

** $p < .01$

group, so the treatment effect must be measured by physical fitness improvement of the experimental group which shows no difference between pretest and posttest measures. The research hypotheses presented in Table 1 cannot be confirmed because the manipulation of the independent variable did not occur.

Students may have reported Cooper points in excess of the actual amount of physical exercise, and verification of the Cooper points by exercise leaders did not always occur. Another method of assessing participation in physical fitness training seems warranted: participation is now being measured by improvement in physical fitness rather than reported Cooper points.

The significant group differences noted on the body fat, resting heart rate, oxygen uptake and fitness category measures point to a major problem with the present study: self selection of subjects to treatment groups. Group differences for body fat and oxygen uptake may be attributed to having more (27% more) males in the experimental group than in the control group; males typically have lower body fat and greater oxygen uptake than do females. The problems of selection are more clearly demonstrated in the resting heart rate and fitness category measures. Likewise scores on the abstraction scale of the Shipley test indicate differences between groups, independent

of treatment. There were also group differences on the Rotter measure: the significant "change scores" on the I-E Scale show that, in general, the experimental group fluctuated more in their perceived locus of control than did the control group. Finally, the variations in student demographics between groups is another problem that may have been alleviated by random assignment of subjects to treatment groups.

Students in both groups improved significantly on the Vocabulary Score, the Total Score, and the predicted WAIS Score on the Shipley-Institute of Living Scale. In studying the test-retest reliability of the Shipley, Goodman, Streiner and Woodward (1974) found consistent and significant increases on Abstraction and WAIS predicted IQ's, while the Vocabulary score was the most stable of the measures on retesting. Female nursing students who were not expecting to be retested participated in the study. Retesting was conducted on subsamples at 2-wk., 1-mo., 2-mo., 3-mo., and 4-mo. intervals. Since the increases in scores were not the greatest after 2-wks., Goodman suggested that, rather than a practice effect, discussion among students about the test may have occurred after the 2-wk testing session, leading to increased scores on the abstraction test. In the present study, while the students may have discussed the test among themselves,

significant changes were found on the Vocabulary score rather than the Abstraction score. A maturation effect may have occurred, with students showing improvement on the vocabulary test as a function of the college semester. The work of Goodman, et al. (1974) needs to be replicated as a reassessment of the test-retest reliability of this measure.

In both groups, students scored higher on the Avoidant learning style on the posttest than on the pretest. This may be due to the increased academic workload at the end of the semester. Academic patterns are also shown in the Daily Log, with students reporting an increase in hours spent studying and thinking efficiency toward the latter weeks of the study.

No consistent patterns on the cognitive measures were found for the 13 individuals who showed improvement in physical fitness. While these data are exploratory in nature, the notions of the popular literature (eg., Kostrubala, 1976; or Ullyot, 1976) were not supported. More rigorous research needs to be conducted before claims for the psychological benefits of physical fitness can be supported.

The present study demonstrates the importance of physical fitness measures in this type of research. Without such measures, a fitness training effect for the experimental

group could have been erroneously assumed. Participation in an exercise program was not sufficient proof of a physical training effect, and no conclusions could thus be drawn as to the effect of an exercise regimen on cognitive performance in college students.

APPENDIX A

DAILY STUDENT LOG

DATE: _____

Name (or Soc.Security No.): _____

DAILY LOG

Please fill out this questionnaire on a daily basis: Mon through Friday. Circle the rating for each item, and fill in the blanks. All responses are confidential, so please be accurate.

MONDAY

Hours spent studying: _____
Hours spent sleeping last night: _____

Sleep quality:	VG	GOOD	MOD	FAIR	POOR	
Performance at work:	VG	GOOD	MOD	FAIR	POOR	N/A
Quality of study time:	VG	GOOD	MOD	FAIR	POOR	N/A
*Alertness during classes:	VH	HIGH	MOD	LOW	VL	N/A
Energy level today:	VH	HIGH	MOD	LOW	VL	
Thinking efficiency today:	VH	HIGH	MOD	LOW	VL	

TUESDAY

Hours spent studying: _____
Hours spent sleeping last night: _____

Sleep quality:	VG	GOOD	MOD	FAIR	POOR	
Performance at work:	VG	GOOD	MOD	FAIR	POOR	N/A
Quality of study time:	VG	GOOD	MOD	FAIR	POOR	N/A
*Alertness during classes:	VH	HIGH	MOD	LOW	VL	N/A
Energy level today:	VH	HIGH	MOD	LOW	VL	
Thinking efficiency today:	VH	HIGH	MOD	LOW	VL	

WEDNESDAY

Hours spent studying: _____
Hours spent sleeping last night: _____

Sleep quality:	VG	GOOD	MOD	FAIR	POOR	
Performance at work:	VG	GOOD	MOD	FAIR	POOR	N/A
Quality of study time:	VG	GOOD	MOD	FAIR	POOR	N/A
*Alertness during classes:	VH	HIGH	MOD	LOW	VL	N/A
Energy level today:	VH	HIGH	MOD	LOW	VL	
Thinking efficiency today:	VH	HIGH	MOD	LOW	VL	

THURSDAY

Hours spent studying: _____
Hours spent sleeping last night: _____

Sleep quality:	VG	GOOD	MOD	FAIR	POOR	
Performance at work:	VG	GOOD	MOD	FAIR	POOR	N/A
Quality of study time:	VG	GOOD	MOD	FAIR	POOR	N/A
*Alertness during classes:	VH	HIGH	MOD	LOW	VL	N/A
Energy level today:	VH	HIGH	MOD	LOW	VL	
Thinking efficiency today:	VH	HIGH	MOD	LOW	VL	

FRIDAY

Hours spent studying: _____
Hours spent sleeping last night: _____

Sleep quality:	VG	GOOD	MOD	FAIR	POOR	
Performance at work:	VG	GOOD	MOD	FAIR	POOR	N/A
Quality of study time:	VG	GOOD	MOD	FAIR	POOR	N/A
*Alertness during classes:	VH	HIGH	MOD	LOW	VL	N/A
Energy level today:	VH	HIGH	MOD	LOW	VL	
Thinking efficiency today:	VH	HIGH	MOD	LOW	VL	

* not including exercise labs.

APPENDIX B

STUDENT LEARNING STYLES

STUDENT LEARNING STYLES

Independent:

This response style is characteristic of the student who likes to think for himself. He prefers to work on his own, but he will listen to the ideas of others in the classroom. He learns the content he feels is important and is confident in his learning abilities.

Avoidant:

This response style is typical of a student who is not interested in learning course content in the traditional classroom. He does not participate with students and teachers in the classroom. He is uninterested or overwhelmed by what goes on in classes.

Collaborative:

This style is typical of the student who feels he can learn the most by sharing his ideas and talents. He cooperates with teachers and peers and likes to work with others. He sees the classroom as a place for social interaction as well as content learning.

Dependent:

This style is characteristic of the student who shows little intellectual curiosity and who learns only what is required. He sees teacher and peers as sources of structure and support. He looks to authority figures for guidelines and wants to be told what to do.

Competitive:

This response style is exhibited by the student who learns material in order to perform better than others in the class. He feels he must compete with other students in the class for the rewards of the classroom, such as grades or teacher's attention. He views the classroom as a win-lose situation, where he must always win.

Participant:

This style is characteristic of the student who wants to learn course content and likes to go to class. He takes responsibility for getting the most out of class and participates with others when told to do so. He feels that he should take part in as much of the class related activity as possible but he does little that is not part of the course outline.

STUDENT LEARNING STYLES QUESTIONNAIRE: GENERAL FORM

The following questionnaire has been designed to help you clarify your attitudes and feelings toward the courses you have taken in college and to identify your preferred learning style(s). Remember, formulate your answers with regard to your general attitudes and feelings toward your courses.

Write your answers on the enclosed questionnaire. To the left of each question number, write the number that best explains how you feel about the statement as follows:

Mark *1* if you *strongly disagree* with the statement.

Mark *2* if you *moderately disagree* with the statement.

Mark *3* if you are *undecided.*

Mark *4* if you *moderately agree* with the statement.

Mark *5* if you *strongly agree* with the statement.

---

1. Most of what I know, I learned on my own.
2. I have a difficult time paying attention during class sessions.
3. I find the ideas of other students relatively useful for helping me to understand the course material.
4. I think a teacher who lets students do whatever they want is not doing his job well.
5. I like other students to know when I have done a good job.
6. I try to participate as much as I can in all aspects of a course.
7. I study what is important to me and not necessarily what the instructor says is important.
8. I feel that I have to attend class rather than feeling that I want to attend.
9. I think an important part of classes is to learn to get along with other people.
10. I accept the structure a teacher sets for a course.
11. To get ahead in class, I think sometimes you have to step on the toes of the other students.
12. I do not have trouble paying attention in classes.
13. I think I can determine what the important content issues are in a course.
14. If I do not understand course material, I just forget about it.
15. I think students can learn more by sharing their ideas than by keeping their ideas to themselves.
16. I think teachers should clearly state what they expect from students.
17. I think students have to be aggressive to do well in school.
18. I get more out of going to class than staying at home.
19. I feel that my ideas about content are often as good as those in a textbook.
20. I try to spend as little time as possible on a course outside of class.

21. I like to study for tests with other students.
22. I like tests taken right out of the book.
23. I feel that I must compete with the other students to get a grade.
24. I attend classes because I want to learn something.
25. I am confident in my abilities to learn important course material.
26. School does not really interest me.
27. I think students should be encouraged to work together.
28. I feel that facts presented in textbooks and lectures are correct.
29. I like the teacher to notice me.
30. I feel that classroom activities are generally interesting.
31. I like to think things through for myself before a teacher lectures on course material.
32. I seldom get excited about material covered in a course.
33. I prefer not to work alone on assignments.
34. Before working on a class project, I try to get the approval of the instructor.
35. To do well in a course, I have to compete with the other students for the teacher's attention.
36. I do my assignments before reading other things that interest me.
37. I do not like a lot of structure in a class.
38. I have given up trying to learn anything from going to class.
39. I like to hear what other students think about the issues raised in class.
40. I think teachers are the best judges of what is important in a course.
41. During class discussions I feel that I have to compete with the other students to get my ideas across.
42. I think classes are very worthwhile.
43. I work on class related projects (e.g., studying for exams, preparing term papers) by myself.
44. I feel that classroom activities are generally boring.
45. I prefer to work in groups rather than alone on class projects.
46. I try my best to do assignments the way the professor says they should be done.
47. I like to see if I can get the answers to problems or questions before anybody else in class does.
48. I am eager to learn about areas covered in class.
49. I do assignments my own way without checking with other students about how they are going to do them.
50. I do not feel that I miss anything if I cut class.
51. I like to talk to other students outside of class about the ideas and issues raised in class.
52. I tend not to think or work on problems or issues in a field unless they were first covered in the text or lectures.
53. I think a student is hurting himself if he shares his notes and ideas with other students before an exam.
54. I feel that I can really learn something in a course.
55. I feel that too much assigned work keeps students from developing their own ideas.
56. I am in school only to get a degree.

57. I try to get to know other students in my classes on a personal level.
58. I think too much class discussion prevents the teacher from covering enough required material.
59. I like to know that I have done better than other students in my class.
60. I do my assignments whether I think they are interesting or not.
61. My ideas about content issues are often as good as those of the instructor.
62. I sit where the teacher is unlikely to notice me.
63. I feel that students and teachers should develop the kind of relationship where a student can tell his teacher if he feels a course is not going well.
64. I feel that I can learn what is important by doing what the professor says.
65. I think students should be graded according to how well they do in a class.
66. I try to do the best that I can in my courses.
67. I do not like a teacher to tell me what I have to learn.
68. I study just hard enough to get by in a course.
69. I like courses where students are encouraged to discuss course material.
70. I seldom try to learn things related to the course that are not covered in the text or lectures.
71. I like to know how well the other students are doing on exams.
72. I feel that I can get something out of going to class.
73. I like courses where students are allowed to pursue topics that interest them.
74. I prefer that the teacher never calls on me.
75. I think learning should be a cooperative effort between faculty and students.
76. I think the teacher should emphasize the content that I must learn.
77. I only help other students when I feel it will not hurt me.
78. I sit where I can be sure to hear the professor and see what he writes.
79. If a topic raised in class interests me, I will go out on my own to find out more about it.
80. I think one of the most important things about a course is how easy it is for me to get a good grade.
81. I try to help other students when they have a hard time understanding course material.
82. I enjoy class sessions that are highly organized.
83. I do not like the instructor to deviate from his lectures.
84. I work on reading assignments until I feel I understand the material.
85. I have my own ideas about how a course should be run.
86. I feel that school is not relevant to what I want to do when I graduate.
87. I feel a responsibility to help other students learn.
88. I try my best to write in my notes everything the teacher says.
89. I try to do assignments better than other students.
90. I do my assignments as soon as possible after assignments are made.

APPENDIX C

SHIPLEY-INSTITUTE OF LIVING SCALE

NAME .....

In the test below, the first word in each line is printed in capital letters. Opposite it are four other words. *Draw a line* under the *one word* which means the *same thing*, or most nearly the same thing, as the first word. A sample has been worked out for you. If you don't know, *guess*. Be sure to underline the *one word* in each line that means the same thing as the first word.

		sample		
LARGE	red	big	silent	wet
		begin here		
(1) TALK	draw	eat	speak	sleep
(2) PERMIT	allow	sew	cut	drive
(3) PARDON	forgive	pound	divide	tell
(4) COUCH	pin	eraser	sofa	glass
(5) REMEMBER	swim	recall	number	defy
(6) TUMBLE	drink	dress	fall	think
(7) HIDEOUS	silvery	tilted	young	dreadful
(8) CORDIAL	swift	muddy	leafy	hearty
(9) EVIDENT	green	obvious	sceptical	afraid
(10) IMPOSTOR	conductor	officer	book	pretender
(11) MERIT	deserve	distrust	fight	separate
(12) FASCINATE	welcome	fix	stir	enchant
(13) INDICATE	defy	excite	signify	bicker
(14) IGNORANT	red	sharp	uninformed	precise
(15) FORTIFY	submerge	strengthen	vent	deaden
(16) RENOWN	length	head	fame	loyalty
(17) NARRATE	yield	buy	associate	tell
(18) MASSIVE	bright	large	speedy	low
(19) HILARITY	laughter	speed	grace	malice
(20) SMIRCHED	stolen	pointed	remade	soiled
(21) SQUANDER	tease	belittle	cut	waste
(22) CAPTION	drum	ballast	heading	ape
(23) FACILITATE	help	turn	strip	bewilder
(24) JOCOSE	humorous	paltry	fervid	plain
(25) APPRISE	reduce	strew	inform	delight
(26) RUE	eat	lament	dominate	cure
(27) DENIZEN	senator	inhabitant	fish	atom
(28) DIVEST	dispossess	intrude	rally	pledge
(29) AMULET	charm	orphan	dingo	pond
(30) INEXORABLE	untidy	involatile	rigid	sparse
(31) SERRATED	dried	notched	armed	blunt
(32) LISSOM	moldy	loose	supple	convex
(33) MOLLIFY	mitigate	direct	pertain	abuse
(34) PLAGIARIZE	appropriate	intend	revoke	maintain
(35) ORIFICE	brush	hole	building	lute
(36) QUERULOUS	maniacal	curious	devout	complaining
(37) PARIAH	outcast	priest	lentil	locker
(38) ABET	waken	ensue	incite	placate
(39) TEMERITY	rashness	timidity	desire	kindness
(40) PRISTINE	vain	sound	first	level

Complete the following. Each dash (__) calls for either a number or a letter to be filled in. Every line is a separate item. Take the items in order, but don't spend too much time on any one.

start here

(1) 1 2 3 4 5 __

(2) white black short long down __ __

(3) AB BC CD D __

(4) Z Y X W V U __

(5) 12321 23432 34543 456 __ __

(6) NE/SW SE/NW E/W N/__

(7) escape scape cape __ __ __

(8) oh ho rat tar mood __ __ __ __

(9) A Z B Y C X D __

(10) tot tot bard drab 537 __ __ __

(11) mist is wasp as pint in tone __ __

(12) 57326 73265 32657 26573 __ __ __ __ __

(13) knit in spud up both to stay __ __

(14) Scotland landscape scapegoat __ __ __ __ee

(15) surgeon 1234567 snore 17635 rogue __ __ __ __ __

(16) tam tan rib rid rat raw hip __ __ __

(17) tar pitch throw saloon bar rod fee tip end plank __ __ __ __ __ meals

(18) 3124 82 73 154 46 13 __

(19) lag leg pen pin big bog rob __ __ __

(20) two w four r one o three __

APPENDIX D

INTERNAL VERSUS EXTERNAL CONTROL SCALE

INSTRUCTIONS

This is a questionnaire to find out the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives lettered a or b. Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you're concerned. Be sure to select the one you actually believe to be more true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal belief; obviously there are no right or wrong answers.

Your answers to the items on this inventory are to be recorded on a seperate answer sheet which has been given to you. Print your name on the answer sheet, then finish reading these instructions.

Please answer these items carefully but do not spend too much time on any one item. Be sure to find an answer for every choice. Find the number of the item on the answer sheet and black-in the space under the number 1 or 2 which you choose as the statement more true.

In some instances you may discover that you believe both statements or neither one. In such cases, be sure to select the one you more strongly believe to be the case as far as you're concerned. Also try to respond to each item independently when making your choice; do not be influenced by your previous choices.

1. a. Children get into trouble because their parents punish them too much.
   b. The trouble with most children nowadays is that their parents are too easy with them.
2. a. Many of the unhappy things in people's lives are partly due to bad luck.
   b. People's misfortunes result from the mistakes they make.
3. a. One of the major reasons why we have wars is because people don't take enough interest in politics.
   b. There will always be wars, no matter how hard people try to prevent them.
4. a. In the long run people get the respect they deserve in this world.
   b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.
5. a. The idea that teachers are unfair to students is nonsense.
   b. Most students don't realize the extent to which their grades are influenced by accidental happenings.
6. a. Without the right breaks one cannot be an effective leader.
   b. Capable people who fail to become leaders have not taken advantage of their opportunities.
7. a. No matter how hard you try some people just don't like you.
   b. People who can't get others to like them don't understand how to get along with others.
8. a. Heredity plays the major role in determining one's personality.
   b. It is one's experiences in life which determine what they're like.
9. a. I have often found that what is going to happen will happen.
   b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.
10. a. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.
    b. Many times exam questions tend to be so unrelated to course work that studying is really useless.
11. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.
    b. Getting a good job depends mainly on being in the right place at the right time.
12. a. The average citizen can have an influence in government decisions.
    b. This world is run by the few people in power, and there is not much the little guy can do about it.
13. a. When I make plans, I am almost certain that I can make them work.
    b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.
14. a. There are certain people who are just no good.
    b. There is some good in everyone.

15. a. In my case getting what I want has little or nothing to do with luck.
    b. Many times we might just as well decide what to do by flipping a coin.
16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.
    b. Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.
17. a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand nor control.
    b. By taking an active part in political and social affairs the people can control world events.
18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.
    b. There really is no such thing as "luck".
19. a. One should always be willing to admit mistakes.
    b. It is usually best to cover up one's mistakes.
20. a. It is hard to know whether or not a person really likes you.
    b. How many friends you have depends upon how nice a person you are.
21. a. In the long run the bad things that happen to us are balanced by the good ones.
    b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.
22. a. With enough effort we can wipe out politican corruption.
    b. It is difficult for people to have much control over the things politicians do in office.
23. a. Sometimes I can't understand how teachers arrive at the grades they give.
    b. There is a direct connection between how hard I study and the grades I get.
24. a. A good leader expects people to decide for themselves what they should do.
    b. A good leader makes it clear to everybody what their jobs are.
25. a. Many times I feel that I have little influence over the things that happen to me.
    b. It is impossible for me to believe that chance or luck plays an important role in my life.
26. a. People are lonely because they don't try to be friendly.
    b. There's not much use in trying too hard to please people, if they like you, they like you.
27. a. There is too much emphasis on athletics in high school.
    b. Team sports are an excellent way to build character.
28. a. What happens to me is my own doing.
    b. Sometimes I feel that I don't have enough control over the direction my life is taking.
29. a. Most of the time I can't understand why politicians behave the way they do.
    b. In the long run the people are responsible for bad government on a national as well as on a local level.

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