THE EFFECTS OF YANG STYLE OF TAI CHI CHUAN ON SELECTED MOTOR AND PHYSICAL VARIABLES

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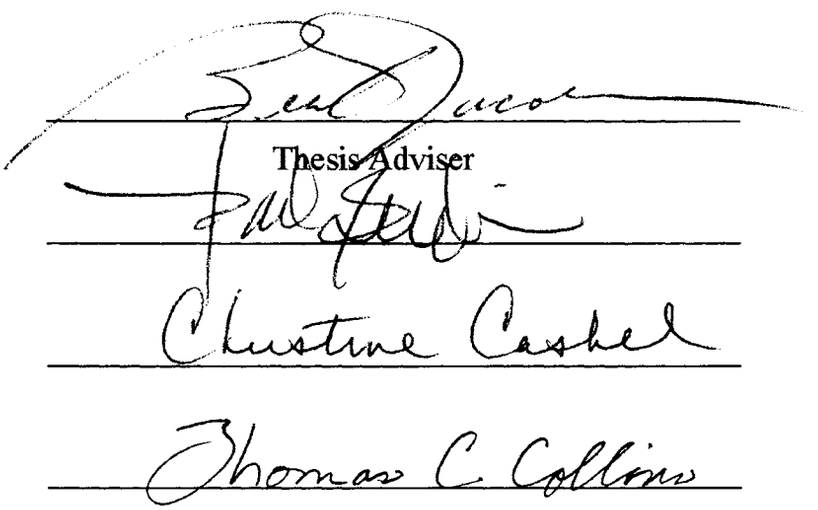

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CHAPTER I

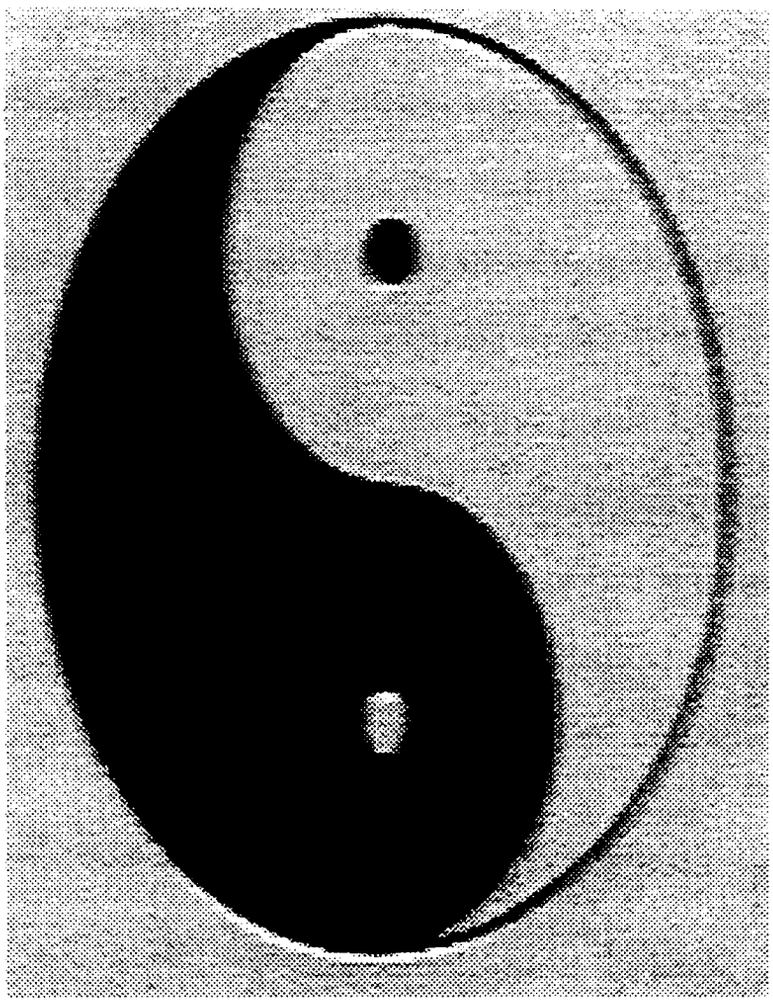
INTRODUCTION OF THE PROBLEM

Tai Chi Chuan originated in China, and sometimes is abbreviated as Taichi or Taiji (Crompton, 1993). According to legend, Tai Chi Chuan was developed by Chang San-Fang in the thirteen century A.D. (Sung Dynasty). One day Chang Sang-Fang saw a snake and a crane fighting (Koh, 1981). The snake twisted its body in a circling movement and easily escaped the crane's attack. The crane attacked the snake many times and finally became exhausted and gave up the fight (Selden, 1979). This phenomena inspired Chang Sang-Fang's imagination, and he created the self-defense movements involving both softness and flexibility (Selden, 1979) which he called" Tai Chi Chuan " (Selden, 1979). However, there are not substantiating documents to prove this legend. Directly translated from Chinese, Tai Chi means " great ultimate ". It involves two meanings, one is Yin , and the other is Yang (Chinese pronunciation) (Selden, 1979). The Chinese think that everything is combined with Yin and Yang. Yin means negative, darkness, or anything which is in a passive principle. However, Yang means positive, sunshine, or anything which is in an active principle (Crompton, 1993). Furthermore, Yin and Yang must interact in a harmonious way (Yang, 1990). If the balance of Yin and Yang is not maintained, something bad or disastrous will

occur (Lau, 1979). During the eleventh century A.D. Chou Thi-Yi, a Taoist, created the diagram (figure I) which now stands for Taichi (Crompton, 1993). The white side represents Yang, and the black side stands for Yin. The white side involves a small black dot. It means that Yang combines with Yin. The black side also includes a small white dot which indicates that Yin combines with Yang (Crompot, 1993). This illustration shows that nothing is completely passive (Yin) or active (Yang). Additionally, it stands for the duality of Yin and Yang. In the movement of Tai Chi Chuan, Yin represents rest, soft, sink, settle, curved, inhalation, passive, and so on. Conversely, Yang stands for motion, firm, rise, float, straight, exhalation, active, and so on (Seledon, 1979). The Chinese also believe that humans have one kind of energy flowing through their body (Yang, 1990). They call this kind of energy "Chi". Yin and Yang are coordinated by Chi. However, Chi cannot be seen or touched, but can be felt and can be controlled by practicing Chi Kung (Yang, 1982). Kung is "kung fu" which means energy and time (Yang, 1990). The Chinese believe that if someone practices Taichi or Chi Kung for a period of time, he will get more energy (Chi) and have good health (Yang, 1990). Moreover, Chinese doctors can detect the Chi circulation by palpation of the radial artery and administrate treatments, such as acupuncture and herbal treatment, in attempt to cure the patient. Therefore, if someone can maintain the harmony between Yin and Yang or control Chi while performing Tai Chi Chuan, he/she should have a good healthy body.

When Taichi was first developed, Taichi skills were not allowed to be taught to other people except the instructor's family or related persons who had the same

Figure 1



surname (Yang, 1982). In the eighteenth century, Chen Chang-Shan, a Tai Chi Chuan master, taught Tai Chi Chuan to a non-related student. This break of tradition diversified the styles of Tai Chi Chuan. The student was Yang Lu-Shann (1780-1873). Yang learned the skills of Tai Chi Chuan and then taught his three sons and other students (Yang, 1982). From that time, Tai Chi Chuan diverted into many branches. The third son of Yang Lu-Shann, Yang Chen-Fu (1883-1935), modified Tai Chi Chuan skills to be the Yang style (Yang, 1982). Wu Chien-Chun learned Tai Chi Chuan from his father. His father, Wu Chun-Yu, learned Tai Chi Chuan from the second son of Yang Lu-Shann, and then Wu Chien-Chun modified some movements and created the Wu style of Tai Chi Chuan. The Wu style of Tai Chi Chuan is now popular in Hong Kong, Singapore, and Malaysia (Yang, 1982). Meanwhile, the Chen Chang-Shan's family also taught and performed their style as Chen style of Tai Chi Chuan (Yang, 1982). There are several styles of Tai Chi Chuan now, because different masters of Tai Chi Chuan created different styles according to their experiences and philosophy, there are: (1) Chen style: quick and slow large movement, (2) Yang style: slow large movement,(3)Wu style: mid paced, and compact, and (4) Sun style: quick, and compact (Jou, 1983). However, all center on use of Chi to achieve balance between Yin and Yang.

Yang style of Tai Chi Chuan is a very slow and soft exercise. There are 108 forms in Yang style (APPENDIX A). The performer must concentrate to perform every form of Tai Chi Chuan, and every form must be performed by utilizing deep breathing. Therefore, the performer perceives any detail changes in his/her body. The entire motions of Tai Chi Chuan always keep the performer's mind calm as

well as relaxes physical tension. Previous research shows that Tai Chi Chuan has some influences on balance (Tse, 1992), cardiovascular, and ventilatory system(Brown, 1989), mental and emotional stress (Jin, 1992). Previous research was focused on the elderly people. However, it is also worth doing research on the effects that Tai Chi Chuan has on the young player.

Statement of the Problem

The problem of this study was to evaluate the effects of performing Tai Chi Chuan on (1) kinesthetic sense, (2) total body's balance, (3) hand strength, and (4) leg strength. The subjects were: (1) beginning Tai Chi Chuan students, (2) six males and six females between the age of 25 and 45, and (3) seven Asian persons and five American persons, and (4) given complete instructions of Yang style of Tai Chi Chuan within twelve weeks.

Hypotheses

The alternative hypotheses were attempted to address the significant increasing effects in subjects on (1) kinesthetic sense in shoulder joint on 30, 45, and 60 degree, (2) total body's balance, (3) muscular strength in the dominant hand, and (4) muscular strength in the dominant leg.

The following null hypotheses (Ho) were tested:

Ho1: There is no significant difference between the pre-test and the post-test in kinesthetic sense of the shoulder joint on 30 degree.

Ho2: There is no significant difference between the pre-test and the post-test in kinesthetic sense of the shoulder joint on 45 degree.

Ho3: There is no significant difference between the pre-test and the post-test in kinesthetic sense of the shoulder joint on 60 degree.

Ho4: There is no significant difference between the pre-test and the post-test in muscular strength of the hand grasp.

Ho5: There is no significant difference between the pre-test and the post-test in muscular strength of the leg extension.

Ho6: There is no significant difference between the pre-test and the post-test in total body's balance.

Ho7: There is no significant difference between the male subjects and the female subjects at any improvement of testing items.

Ho8: There is no significant difference between the American subjects and Asian subjects at any improvement of testing items.

Ho9: There is no significant difference between the interactions of race and gender at any improvement of testing items.

Delimitations

The following were the delimitations of this study:

1. The total number of subjects volunteering for this study was 12.
2. The subjects performed Taichi three days per week under the supervision of the investigator.
4. All the subjects were not under the influence of drugs or stimulants for 48 hours before testing.
5. The study was conducted for a period of twelve weeks between August and October.

Limitations

This study was subject to the following limitations:

1. The sample size of this study is small (n=12) necessitating caution in extrapolation of the data to a large population.

2. The subjects' daily activities (except for performing Taichi) were not controlled.

3. The subjects were not be able to perform Taichi at entirely the same angles and movements.

4. The subjects were not the same race. There are 7 Asia persons and 5 American persons.

Assumptions

For the purpose of this study, the following assumptions were accepted by the researcher:

1. All subjects correctly followed the testing procedure.

2. The subjects were able to perform 108 forms of Yang style of Taichi before the post-test.

3. The subjects were able to perform all pre-test and post- test to the basis of their ability.

4. Subjects abstained from any activity which may influence the tests before they were tested.

Definitions

(1) Tai Chi: Chinese philosophy which means " great ultimate ", and involves " Yin and Yang "

(2) Tai Chi Chuan: an exercise according to the Tai Chi philosophy

(3) Yin: anything which is passive, or negative principle

(4) Yang: anything which is active, or positive principle

(5) Chi: the energy flowing through the body

(6) Chi Kung: an exercise which is able to get Chi (energy)

(7) Kinesthetic sense: the perceiving of the body's position on the space

(8) Ho: null hypothesis

(9) Ha: alternation hypothesis

(10) Form: every motion of Tai Chi Chuan was given a name which represents a form

(11) AM: American male

(12) MA: Asian male

(13) AF: American female

(14) FA: Asian female

CHAPTER II

LITERATURE REVIEW

Introduction

Performing Tai Chi Chuan is a very common exercise in Asia and is popular in China. Because of the popularity of Tai Chi Chuan, Tai Chi Chuan finally became a sporting event in the Asian games in 1990. The performers think that it is easy to learn Tai Chi Chuan skills because there are not a lot of principles and rules to follow, and Tai Chi Chuan can be learned by any person regardless of age. The application aspect in Tai Chi Chuan is " pushing hands" in which two people stand face to face to a attack or defend themselves by using Tai Chi Chuan skills. But most of the performers practice Tai Chi Chuan because they believe Tai Chi Chuan will benefit their health. However, Yin and Yang or Chi-Kung philosophy is always hard to prove by using scientific methods. Therefore, most of the research focused on the function of Tai Chi Chuan that affected human physiology or psychology. For organizational purpose, the related literature is presented under the following topics: (1) Tai Chi Chuan and cardiovascular and ventilatory system; (2) Tai Chi Chuan and balance; (3) Tai Chi Chuan and mental, emotional stress; and (4) Tai Chi Chuan with other aspects.

Tai Chi Chuan and cardiovascular and ventilatory system

Tai Chi Chuan has been found to improve the circulation (Cheng & Smith, 1967; Jou, 1983). In a study by Brown (1989), six subjects performed Yang style of Tai Chi Chuan, and then tested the form "both hands wave like a cloud" to obtain ventilatory and cardiovascular data, which were compared with the responses during cycle ergometry at the same oxygen consumption and the same subjects. The data revealed that when the subjects performed Tai Chi Chuan, the ventilatory frequency, ventilatory equivalent (VE/VO2) and the ratio of dead space ventilatory to the tidal volume (VD/VA) was significantly lower than when the subjects performing cycle ergometry. Brown, Mucci el. al (1989) suggested that Tai Chi Chuan performers can get a more efficient use of ventalitory volume and can develop ventalitory efficiency without presence of cardiovascular stress. A study by Schneider and Leung (1991) revealed that Tai Chi Chuan performers can utilize more efficient breathing patterns during exercise than the Wing Chun performers. Recently research indicated that the Tai Chi Chuan performers had a significant higher oxygen uptake (VO2), O2 pulse, and work rate than sedentary subjects (Lai-JS, 1994).

Tai Chi Chuan and balance

Previous research has showed that Tai Chi Chuan performers had significantly greater postural control than non-Tai Chi Chuan performers (Tse, Shuk, 1992). However this research is a post hoc comparison, therefore the research suggested that it maybe an association between Tai Chi Chuan and balance.

Tai Chi Chuan and mental, emotional stress

Tai Chi Chuan has been shown to have an effect on mental and physical relaxation (Jin, 1989). Jin demonstrated that Tai Chi Chuan performers reported less tension, anger, depression, confusion, fatigue, state-anxiety, and total mood disturbance, moreover, the performers felt more vigorous. In another study by Jin (1992), Tai Chi Chuan performers reduced stress, and alteration in heart rate, and blood pressure was found to be similar to exercisers who walked at a speed of 6 km/hr.

Tai Chi Chuan with other aspects

Tai Chi Chuan was found to be safe for rheumatoid arthritis patients. The patients can perform Tai Chi Chuan as their exercise without any disadvantage and it may have the potential advantage to stimulate bone growth and strengthen connective tissue (Kirsteins-AE, Dietz-F, and Hwang-SM, 1991).

Tai Chi Chuan may increase the T-lymphocytes (or T-cell) which can destroy bacteria and possible even tumor cells (Prevention, 1990). In this study , 30 healthy elderly subjects had blood samples taken before and after performing Tai Chi Chuan. These blood samples were compared with 30 non-Tai Chi Chuan performers. The results revealed that the original blood samples of Tai Chi Chuan performers were higher than non-Tai Chi Chuan performers, and a 13 percent average increase in active T-cells over their original level of Tai Chi Chuan performers.

CHAPTER III

METHODOLOGY

Introduction

The problem of the study was to evaluate the performing Tai Chi Chuan on muscular strength, balance, and kinesthetic sense. The methodology system of this study includes the following procedural steps: (1) selection of subject, (2) selection of test instruments, (3) design of the study and (4) treatment of data.

Selection of the Subjects

Twelve subjects were chosen from the Oklahoma State University campus on a voluntary basis. All subjects has signed a consent form (APPENDIX B) which was approved by the university Institutional Review Board. The main criteria for participation included (1) all subjects were healthy and did not have any disabilities, (2) subjects' age ranged from 25 to 45 years old.

These criteria were selected to give the study to an internal validity factor which would appropriately apply to a large population.

Selection of the Test Instruments

Subjects were assessed using the following six measures: (1) isometric muscular strength of the dominant hand by using the Lafayette hand dynamometer (Model 78010), (2) isometric muscular strength of dominant leg by using the Lafayette cable tensiometer set (Model J00115), (3) body balance by the Lafayette stability platform (Model 16020), (4) 30, 45, and 60 degree of kinesthetic sense of shoulder joint and slightly elbow joint by the Lafayette kinesthesiometer (Model 16014). All subjects were identically pre-tested and a post-tested using these six measures of balance, muscular strength, and kinesthetic sense. All measures were repeated three times and the best value was chosen to be compared between pre-test and post-test.

Design of the study

Following the pre-test, the subjects were taught 108 forms of Yang style of Tai Chi Chuan over a twelve week period, consisting of three times per week and 45 minutes each session . All subjects were post-tested after they had learned all 108 forms of Yang style of Tai Chi Chuan.

The dominant muscular hand strength was measured in grip strength by three trials. The tests required every subject to maintain an anatomic position and were not allowed to watch the instrument during testing. Dominant leg strength was measured by leg extension for three trials (Lester, 1984), and during each trial the subjects held their hands on their chest to avoid assisting in the movement. Kinesthetic sense of the slightly elbow joint and shoulder joint was measured in shoulder rotation and elbow flexion in angles of 30, 45, and 60 degrees. First, subjects were seated and blind folded during the test to avoid seeing the positions. Second, the subject's hand was positioned from 0 degree to 30 or 45 or 60

degrees and returned to 0 degree to the original position, and one second was allowed to perceive and find the original position. Body balance required the subjects to maintain their balance on a stability platform for thirty seconds. Total times in balance and number of times off balance were recorded electronically by a timer which measured data in milliseconds.

Both the pre-test and the post-test were administered by the investigator and the research advisor in the Exercise Physiology laboratory on the Oklahoma State University campus. The instructions of Tai Chi Chuan were performed by the researcher for forty five minutes per day, and three days per weeks within twelve weeks. The instructional contents of Yang style of Taichi were combined with movement and natural breathing.

Treatment of Data

To test the six null hypotheses, the dependent t-tests were conducted to calculate the pre-test and post-test. The null hypotheses were tested by using one-tailed test at a 0.05 level of significance. An analysis of variance (ANOVA) was used to analyze the differences between gender and race.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

This research chose alpha level of $p<0.05$ to conduct the statistical analyses, and the assumptions were(1) population of difference is normal, and (2) random sample from population of differences. The parameters were defined to (1) U1= true mean of pre-test scores, and (2) U2= true mean of post-test scores. Therefore, the null hypothesis (Ho) was U1= U2, and the alternative hypothesis (Ha) was U1<U2. The null distribution was t-distribution with 11 degrees of freedom or t-distribution with 10 degrees of freedom on dominant leg strength because one female subject was one month pregnant before post-tested period, therefore, she was unable to do the leg test. All data and computing procedure is in APPENDIX C.

Tai chi and kinesthetic sense on shoulder joint on 30 degree

TABLE I

	PRE-TEST	POST-TEST	Dependent t-test
KINESTHETIC SENSE (30 DEGREE)	MA1=31 MA2=28 AM3=28.5 MA4=21 MA5=28.5 AM6=28 AF1=31 AF2=19 FA3=21.5 FA4=28 FA5=28 AF6=28	MA1=31.5 MA2=28 AM3=29 MA4=30 MA5=26 AM6=29 AF1=34 AF2=24 FA3=29 FA4=27 FA5=24 AF6=28	Mean of absolute (pre-test scores - 30) = 3.625 Mean of absolute (post-test scores - 30) = 2.625 Mean =1.0000000 Standard Deviation =4.0898989 Observations =12 df =11 t =0.8469869

Kinesthetic sense at 30 degree	P(T<=t) one tail	Significant level	Reject or Accept Null Hypothesis 1
	0.42349	0.05	Accept Ho1

Tai chi and kinesthetic sense on shoulder joint on 45 degree

Table II

	PRE-TEST	POST-TEST	Dependent t-test
KINESTHETIC SENSE (45 DEGREE)	MA1=45.8 MA2=38 AM3=49.5 MA4=43 MA5=47 AM6=42.5 AF1=51 AF2=39 FA3=39 FA4=38 FA5=41 AF6=41	MA1=45 MA2=37 AM3=39 MA4=45 MA5=36 AM6=42 AF1=40 AF2=39 FA3=41 FA4=41 FA5=39 AF6=44	Mean of absolute (pre-test scores - 45) = 4.3167 Mean of absolute (post-test scores - 45) = 4.3333 Mean =0.1500000 Standard Deviation = 2.7612579 Observations =12 df =11 t =0.1881806

Kinesthetic sense at 45 degree	P(T<=t) one tail	Significant level	Reject or Accept Null Hypothesis 2
	0.4271	0.05	Accept Ho2

Tai chi and kinesthetic sense on shoulder joint on 60 degree

Table III

	PRE-TEST	POST-TEST	Dependent t-test
KINESTHETIC SENSE (.60 DEGREE)	MA1=71 MA2=57 AM3=55 MA4=58 MA5=68 AM6=59 AF1=61 FA2=66 FA3=50 FA4=58 AF5=58 AF6=66	MA1=62 MA2=55 AM3=58 MA4=59 MA5=64 AM6=58 AF1=60.5 FA2=63 FA3=54.5 FA4=58 AF5=59 AF6=63	Mean of absolute (pre-test scores - 60) = 4.6667 Mean of absolute (post-test scores - 60) = 2.5833 Mean =2.5000000 Standard Deviation = 2.6371472 Observations =12 df =11 t =3.2839479

Kinesthetic sense at 60 degree	P(T<=t) one tail	Significant level	Reject or Accept Null Hypothesis 3
	0.00365	0.05	Reject Ho3

Taichi and balance

Table IV

	PRE-TEST	POST-TEST	Dependent t-test
BALANCE	MA1=12.37 SEC MA2=16.7 MA3=15.2 AM4=14.9 MA5=10 AM6=17.65 AF1=17.88 FA2=9.98 FA3=9.32 FA4=6.78 AF5=14.41 AF6=22.05	MA1=13.3 MA2=26.4 MA3=16.4 AM4=17.77 MA5=26.74 AM6=26.90 AF1=27.77 FA2=23.2 FA3=16 FA4=16.75 AF5=17.13 AF6=27.05	Mean of pre-test scores = 13.9367 Mean of post-test scores = 21.2842 Mean =7.6641667 Standard Deviation = 5.4727647 Observations =12 df =11 t =4.8511956

Balance	P(T<=t) one tail	Significant level	Reject or Accept Null Hypothesis
	0.00025	0.05	Reject Ho6

Taichi and muscular strength on dominant hand

Table V

	PRE-TEST	POST-TEST	Dependent t-test
MUSCULAR STRENGTH ON DOMINANT HAND	MA1=35 MA2=41 AM3=60 MA4=40 MA5=57 AM6=67.5 FA1=21.5 FA2=31 FA3=22 AF4=26 AF5=31.5 AF6=27	MA1=44 MA2=47.5 AM3=64 MA4=43 MA5=57 AM6=67 FA1=26 FA2=32.5 FA3=28.5 AF4=27.5 AF5=31.5 AF6=32	Mean of pre-test scores = 36.4167 Mean of post-test scores = 39.5 Mean =3.4166667 Standard Deviation = 3.0213884 Observations =12 df =11 t=3.9172986

Hand Strength	P(T<=t) one tail	Significant level	Reject or Accept Null Hypothesis 4
	0.0012	0.05	Reject Ho4

Taichi and muscular strength on dominant leg

Table VI

	PRE-TEST	POST-TEST	Dependent t-test
MUSCULAR STRENGTH ON DOMINANT LEG	MA1=5 MA2=38 AM3=38.5 MA4=40.5 MA5=52 AM6=60 AF1=18 AF2=31 FA3=11 FA4=31 AF5=22 FA6=.	MA1=6 MA2=37 AM3=38 MA4=40 MA5=70 AM6=72 AF1=19 AF2=21 FA3=31.5 FA4=33 AF5=23 FA6=.	Mean of pre-test scores = 33.2 Mean of post-test scores = 37.25 Mean =3.9545455 Standard Deviation = 9.0814496 Observations =11 df =10 t =1.4442346

Leg Strength	P(T<=t) one tail	Significant level	Reject or Accept Null Hypothesis 5
	0.08965	0.05	Accept Ho5

TABLE VII

ANOVA TEST

KINESTHETIC SENSE AT 60 DEGREE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	16.5000000	5.5000000	0.73	0.5607
Error	8	60.0000000	7.5000000		
Corrected Total	11	76.5000000			

Source	DF	Type I SS	Mean Square	F valve	Pr > F
Gender	1	3.0000000	3.0000000	0.40	0.5447
Race	1	10.6764705	10.6764705	1.42	0.2670
Gender & race	1	2.8235294	2.8235294	0.38	0.5565

Source	DF	Type III SS	Mean Square	F valve	Pr > F
gender	1	0.70588235	0.70588235	0.09	0.7668
race	1	1.29411176	1.29411176	1.51	0.2547
gender & race	1	2.82352941	2.82352941	0.38	0.5565

Kinesthetic sense (60 degree)	Reject or Accept Null Hypothesis 7	Reject or Accept Null Hypothesis 8	Reject or Accept Null Hypothesis 9
	Accept Ho7	Accept Ho8	Accept Ho9

TABLE VIII

ANOVA TEST

HAND STRENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	17.7708333	5.92361111	0.57	0.6483
Error	8	82.6458333	10.3307291		
Corrected Total	11	100.416666			

Source	DF	Type I SS	Mean Square	F valve	Pr > F
Gender	1	0.75000000	0.75000000	0.07	0.7944
Race	1	16.4803921	16.4803921	1.60	0.2421
Gender & race	1	0.54044118	0.54044118	0.05	0.8248

Source	DF	Type III SS	Mean Square	F valve	Pr > F
gender	1	0.11122549	0.11122549	0.00	0.9916
race	1	16.7757352	16.7757352	1.62	0.2383
gender & race	1	0.54044118	0.54044118	0.05	0.8248

Hand Strength	Reject or Accept Null Hypothesis 7	Reject or Accept Null Hypothesis 8	Reject or Accept Null Hypothesis 9
	Accept Ho7	Accept Ho8	Accept Ho9

TABLE IX

ANOVA TEST

BALANCE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	53.8953500	17.9651166	0.52	0.6793
Error	8	275.567341	34.4459177		
Corrected Total	11	329.462691			

Source	DF	Type I SS	Mean Square	F valve	Pr > F
Gender	1	9.34567500	9.34567500	0.27	0.6166
Race	1	31.6743686	31.6743686	0.92	0.3657
Gender & race	1	12.8753063	12.8753063	0.37	0.5579

Source	DF	Type III SS	Mean Square	F valve	Pr > F
gender	1	10.6860591	10.6860591	0.31	0.5928
race	1	29.2376122	29.2376122	0.85	0.3838
gender & race	1	12.8753063	12.8753063	0.37	0.5579

Balance	Reject or Accept Null Hypothesis 7	Reject or Accept Null Hypothesis 8	Reject or Accept Null Hypothesis 9
	Accept Ho7	Accept Ho8	Accept Ho9

Results of kinesthetic sense on 30 degree

Statistical analysis indicated that there was no sufficient evidence at the significant level = 0.05 to conclude that the true mean of post-test scores of kinesthetic sense on 30 degree of Tai Chi performers is greater than the true mean of pre-test scores. Therefore, the Ho1 is accepted.

Results of kinesthetic sense on 45 degree

Statistical analysis indicated that there was no sufficient evidence at the significant level = 0.05 to conclude that the true mean of post-test scores of kinesthetic sense on 45 degree of Tai Chi performers is greater than the true mean of pre-test scores. Therefore, the Ho2 is accepted.

Results of kinesthetic sense on 60 degree

Statistical analysis indicated that there was sufficient evidence at the significant level =0.05 to conclude that the true mean of post-test scores of kinesthetic sense on 60 degree of Tai Chi performers is greater than the true mean of pre-test scores. Therefore, the Ho3 is rejected.

Results of balance

Statistical analysis indicated that there was sufficient evidence at the significant level 0.05 to conclude that the true mean of post-test scores of balance of Tai Chi performers is greater than the true mean of pre-test scores. Therefore, the Ho6 is rejected.

Results of hand strength

Statistical analysis indicated that there was sufficient evidence at the significant level = 0.05 to conclude that the true mean of post-test scores of hand strength of Tai Chi performers is greater than the true mean of pre-test scores. Therefore, the Ho4 is rejected.

Results of leg strength

Statistical analysis indicated that there is no sufficient evidence at the significant level = 0.05 to conclude that the true mean of post-test scores of leg strength of Tai Chi performers is greater than the true mean of pre-test scores. Therefore, the Ho5 is accepted.

Results of the ANOVA TESTS

According to the TABLE VII, VIII, and IX, the improvements of kinesthetic sense at 60 degree, hand strength, and balance were not significantly different between male and female, and between American and Asian, and between the interactions of gender and race. The Ho7, Ho8, and Ho9 are accepted. Therefore, any one who performed Tai Chi Chuan is supposed to make a progress in kinesthetic sense at 60 degree, hand strength, and balance after 12 weeks without the limitations by gender and race.

Discussion of results

Statistical analyses revealed that Tai Chi Chuan performers were able to enhance balance, hand strength ,and improve kinesthetic senses at 60 degrees, however, the performers were not able to increase the leg strength and the kinesthetic sense at 30, and 45 degree after 12 weeks Tai Chi performing.

Possible explanations for these results were

(1) Balance: the balance was the most important rule in performing Tai Chi Chuan. Numerous forms must use one leg to stand and to move weight and posture to the next sequential form. Such movements required consistent maintenance of balance, otherwise, the performers were not able to finish the entire forms. Therefore, it is possible that the balance requirements of performing Tai Chi Chuan translated into enhancing balancing abilities.

(2) Hand strength: the hand strength increased possibly because the performers concentrated on their hand's movements, and therefore the supporting contractions of the appropriate muscles was involved. This concentration may explain the increase in hand strength.

(3) Kinesthetic sense at 60 degree: the increase of kinesthetic sense at 60 degree on shoulder joint in shoulder rotation and elbow flexion because Tai Chi Chuan performers performed their movement largely, precisely , and slowly, therefore, the large degree (60) of movement was improved.

(4) Kinesthetic sense at 30, and 45 degree: the kinesthetic sense is not easy to improve in a short period of time on the small degree (45, and 30). As such, the training of Tai Chi Chuan within 12 weeks possibly was not a suitable duration to achieve a better results on the small degree of kinesthetic sense.

(5) Leg strength: the leg strength was not improved which the performers possibly did not concentrate on the leg's movement as much as their hands', and

the instructor did not ask subjects to lower bodies during practice, which would have involved greater knee bend and stress on leg's muscle. Therefore, more time may be necessary to get used to all the movements, and then concentrate on the legs' movements. In this way the performers may increase their legs strength.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATION FOR FUTURE STUDY

Summary

Statistical analyses indicated that Tai Chi Chuan performers significantly enhanced balance, hand strength, and kinesthetic sense on 60 degree after 12 weeks of treatment. The finding on balance is supported by the other available research which was conducted on aged people (Tse, Shuk, 1992). However, in the present study, all subjects between the age of 25 and 45 improving in balance. The finding of increase of hand strength is a new issue. No other research has showed that Tai Chi Chuan can enhance hand strength. Furthermore, the improvement of 60 degree of kinesthetic sense is also new. These results indicate that Tai Chi Chuan may be an ancillary exercise for the patients with motor control difficulty. The leg strength did not improve during 12 weeks performance, and the kinesthetic sense on 30, and 45 degrees did not have significant improvement.

Conclusions

Tai Chi Chuan was able to enhance the hand's grip strength only in this study currently, however, the other places of hand strength like pulling and pushing strengths by performing Tai Chi Chuan can also be estimated. Additional research may focus on the strengths of different parts of the human body which is needed to substantiate more strength issues. The kinesthetic sense improved by performing Tai Chi Chuan is also a new issue. However, this research just chose shoulder rotation and elbow flexion at 30, 45, and 60 degree. Additional research can be executed by a lot of different movements and degrees to provide more evidences.

Recommendations for further study

The Asian games were completed on Oct. 16, 1994 in Japan, and the activity of Tai Chi Chuan had more Asian countries competed than before. Therefore, a lot of countries are discovering Tai Chi Chuan to be a more popular exercise because it does not need special equipment or abilities. However, it does require practice, precision and proper conduct. This is a good alternative for people of all ages. Benefits have been shown in previous studies on older persons, and this study demonstrated benefits on persons in a relatively short time. Further study should include a control group to compare with experimental group in order to make sure that any improvement is not related to the instrumental learning skills. Furthermore, the kinesthetic sense can be tested by different motions, especially extension rather than flexion because most of Tai Chi Chuan's movement is focused on the extension. The strength should be tested by more movements, such as hand's pulling and pushing strength. Actually, more research should be done to

relate fitness and health issues to Tai Chi Chuan. Especially in resisting the disease and getting a good health by performing Tai Chi Chuan.

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APPENDIXES

APPENDIX A

108 FORMS OF YANG STYLE OF TAI CHI CHUAN

APPENDIX A

108 FORMS OF YANG STYLE OF TAI CHI CHUAN

1. RAISE BOTH HANDS AND PUSH DOWN
2. BEGINNING FORM OF TAI CHI CHUAN
3. RAISE RIGHT HAND
4. OBLIQUE FLYING
5. WARD OFF
6. ROLL BACK
7. PRESS
8. PUSH
9. SINGLE WHIP
10. LIFT HANDS & LEAN FORWARD
11. WHITE CRANE SPREADS WING
12. BRUSH KNEE AND STEP FORWARD (LEFT)
13. HANDS PLAY THE LUTE
14. BRUSH KNEE AND STEP FORWARD (LEFT, RIGHT AND LEFT)
15. HANDS PLAY THE LUTE
16. BRUSH KNEE AND STEP FORWARD (LEFT)
17. TWIST BODY & CIRCLE FIST & STEP FORWARD & PARRY & PUNCH
18. AS IF CLOSING A DOOR
19. CROSS HANDS

20. CARRY TIGER AND RETURN TO MOUNTAIN
21. ENDING OF TAI CHI SECTION #1
22. OBLIQUE WARD OFF
23. ROLL BACK
24. PRESS
25. PUSH
26. SINGLE WHIP
27. FIST UNDER ELBOW
28. STEP BACK AND WHIRL ARMS (LEFT, RIGHT & LEFT)
29. OBLIQUE FLYING
30. LIFT THE HANDS & LEAN FORWARD
31. WHITE CRANE SPREADS WING
32. BRUSH KNEE AND STEP FORWARD
33. NEEDLE AT THE SEA BOTTOM
34. FAN THROUGH THE ARM
35. TURN BODY AND THROW FIST
36. CIRCLE FIST & STEP FORWARD & PARRY & PUNCH
37. WARD OFF & ROLL BACK & PRESS & PUSH
38. SINGLE WHIP
39. BOTH HANDS WAVING LIKE THE CLOUDS
40. SINGLE WHIP
41. STAND HIGH TO SEARCH OUT THE HORSE
42. SEPARATE RIGHT FOOT
43. SEPARATE LEFT FOOT
44. PIVOT BODY AND KICK THE WITH LEFT HEEL
45. BRUSH KNEE AND STEP FORWARD (LEFT & RIGHT)
46. BRUSH KNEE AND PUNCH DOWN

47. PIVOT BODY AND WHITE SNAKE PUT OUT THE TONGUE
48. CIRCLE FIST & STEP FORWARD & PARRY & PUNCH
49. KICK RIGHT
50. RIGHT TAME TIGER
51. LEFT TAME TIGER
52. KICK WITH RIGHT HEEL ON MIDDLE DIRECTION
53. STRIKE EARS WITH FISTS
54. CROSS HANDS, KICK WITH LEFT HEEL AND PIVOT BODY
55. KICK RIGHT HEEL
56. CIRCLE FIST & STEP FORWARD & PARRY & PUNCH
57. AS IF CLOSING A DOOR
58. CROSS HANDS
59. CARRY TIGER AND RETURN TO MOUNTAIN
60. ENDING OF TAI CHI SECTION #2
61. WARD OFF & ROLL BACK & PRESS & PUSH
62. OBLIQUE SINGLE WHIP
63. WILD HORSES SHARE MANE (RIGHT)
64. WILD HORSE SHARES MANE (LEFT)
65. WILD HORSE SHARES MANE (RIGHT)
66. WILD HORSE SHARES MANE (LEFT)
67. WARD OFF & ROLL BACK & PRESS & PUSH
68. SINGLE WHIP
69. FAIR LADY WAVES SHUTTLE (RIGHT)
70. FAIR LADY WAVES SHUTTLE (LEFT)
71. FAIR LADY WAVES SHUTTLE (RIGHT)
72. FAIR LADY WAVES SHUTTLE (LEFT)
73. WARD OFF & ROLL BACK & PRESS & PUSH

74. SINGLE WHIP
75. BOTH HANDS WAVING LIKE THE CLOUDS
76. SINGLE WHIP
77. SINGLE WHIP AND SNAKE CROUCH DOWN
78. GOLDEN ROOSTER STANDS ON ONE LEG (LEFT)
79. GOLDEN ROOSTER STANDS ON ONE LEG (RIGHT)
80. STEP BACK AND WHIRL ARMS
81. OBLIQUE FLYING
82. LIFT HANDS & LEAN FORWARD
83. WHITE CRANE SPREADS WING
84. BRUSH KNEE & STEP FORWARD
85. NEEDLE AT THE SEA BOTTOM
86. FAN THROUGH THE ARM
87. PIVOT BODY & THROW BOTH FISTS
88. CIRCLE FIST & STEP FORWARD & PARRY & PUNCH
89. WARD OFF & ROLL BACK & PRESS & PUSH
90. SINGLE WHIP
91. BOTH HANDS WAVING THE CLOUDS
92. SINGLE WHIP
93. STAND HIGH TO SEARCH OUT THE HORSE
94. PIVOT BODY & ROTATE HANDS & KICK WITH RIGHT HEEL
95. BRUSH KNEE AND STRAIGHT LOW PUNCH
96. WARD OFF & ROLL BACK & PRESS & PUSH
97. SINGLE WHIP
98. SINGLE WHIP & SNAKE CROUCH DOWN
99. STEP FORWARD TO SEVEN STARS
100. STEP BACK & RIDE THE TIGER

101. SINGLE SWEEP LOTUS WITH LEFT LEG

102. DOUBLE SWEEP LOTUS WITH RIGHT LEG

103. BEND THE BOW TO SHOOT THE TIGER

104. CIRCLE FIST & STEP FORWARD & PARRY & PUNCH

105. AS IF CLOSING A DOOR

106. CROSS HANDS

107. CARRY TIGER & RETURN TO MOUNTAIN

108. RETURN TO ORIGINAL STANCE

APPENDIX B

CONSENT FORM DOCUMENT

HUMAN SUBJECTS CONSENT FORM

Oklahoma State University

I, ----------voluntarily agree to participate in this study entitled: " The effects of Tai Chi Chuan on Selected Motor and Physical Variables."

1. Purpose. This study involves research that will be carry out under the supervision of Bert H. Jacobson, Ed.D. (principle investigator) and Chen Ho-Cheng. The purpose of this research is to investigate the effects of performing Yang style of Tai Chi Chuan on kinesthetic sense, balance and strength.

2. Procedure. Tests will include (1) kinesthetic sense (2) balance (3) strength in hand and leg. These tests will perform twice. The pre-test will be done before performing Tai Chi Chuan, and the post-test will be done after completely performing 108 forms of Yang style of Tai Chi Chuan.

3. Duration. The subjects will perform Tai Chi Chuan 45 minutes each session, three times a week. The full duration of this study will take 12 weeks.

4. Extent. Subject' data will be maintained confidentially throughout the entire study.

" I understand that participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty after notifying the project director."

If I have any questions about my rights as a research subject, I may contact Chen Ho-Cheng at telephone number (405) 744-1729, or I may contact the office of University Research Service, 001 Life Science East, Oklahoma State University, Stillwater. Ok 74075; Telephone: (405) 744-5700.

I have read and fully understand the consent form. I sign it freely and voluntarily. I also acknowledge that I have not waived any of my rights.

Date:---------- Time:----------(a.m.\p.m.)

Sign:----------

signature of subject

" I certify that I have personally explained all elements of this form to the subject before requesting the subject sign it."

Signed:----------

Project Director or Authorized Representative

APPENDIX C

SUBJECTS DATA AND COMPUTING PROCEDURE

COMPUTER PROGRAM

```
DATA;
INPUT SEX $ NATION $ POK60 PRK60 POK45 PRK45 POK30 PRK30
POBAL PRBAL
    POHS PRHS POLS PRLS;
DIFF1=ABS(PRK60-60)-ABS(POK60-60);
DIFF2=ABS(PRK45-45)-ABS(POK45-45);
DIFF3=ABS(PRK30-30)-ABS(POK30-30);
DIFF4=POBAL-PRBAL;
DIFF5=POHS-PRHS;
DIFF6=POLS-PRLS;
CARDS;
F A 59 58 44 41 28 28 27.77 17.88 32 27 23 22
F A 63 66 40 51 34 31 27.05 22.05 31.5 31.5 19 18
F A 60.5 61 39 39 24 19 17.13 14.41 27.5 26 21 31
F C 63 66 41 39 29 21.5 16.75 6.78 28.5 22 31.5 11
F C 54.5 50 41 38 27 28 16 9.32 32.5 31 33 31
F C 58 58 39 41 24 28 27 9.98 26 21.5 . .
M A 58 59 42 42.5 29 28 26.9 17.65 67 67.5 72 60
M C 64 68 36 47 26 28.5 26.4 16.7 57 57 70 52
M C 59 58 45 43 30 21 16.4 15.2 43 40 40 40.5
M A 58 55 39 49.5 29 28.5 17.77 14.9 64 60 38 38.5
M C 57 55 38 37 28 28 26.74 10 47.5 41 37 38
M C 62 71 45 45.8 31.5 31 13.30 12.37 44 35 6 5
;
PROC PRINT;
PROC MEANS MEAN STD T PRT;
 VAR DIFF1;
 TITLE 'PAIRED T TEST, TEST ITEM : KINESTHETIC SENSE AT 60
DEGREE';
PROC MEANS MEAN STD T PRT;
 VAR DIFF2;
 TITLE 'PAIRED T TEST, TEST ITEM : KINESTHETIC SENSE AT 45
DEGREE';
PROC MEANS MEAN STD T PRT;
 VAR DIFF3;
 TITLE 'PAIRED T TEST, TEST ITEM : KINESTHETIC SENSE AT 30
DEGREE';
PROC MEANS MEAN STD T PRT;
 VAR DIFF4;
 TITLE 'PAIRED T TEST, TEST ITEM : BALANCE';
PROC MEANS MEAN STD T PRT;
 VAR DIFF5;
 TITLE 'PAIRED T TEST, TEST ITEM : HAND STRENGTH';
PROC MEANS MEAN STD T PRT;
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 VAR DIFF6;
 TITLE 'PAIRED T TEST, TEST ITEM : LEG STRENGTH';
PROC GLM;
  CLASS SEX NATION;
  MODEL DIFF1=SEX NATION SEX*NATION;
  TITLE 'ANOVA ANALYSIS, TEST ITEM : KINESTHETIC SENSE AT 60
DEGREE';
PROC GLM;
  CLASS SEX NATION;
  MODEL DIFF4=SEX NATION SEX*NATION;
  TITLE 'ANOVA ANALYSIS, TEST ITEM : BALANCE';
PROC GLM;
  CLASS SEX NATION;
  MODEL DIFF5=SEX NATION SEX*NATION;
  TITLE 'ANOVA ANALYSIS, TEST ITEM : HAND STRENGTH';
RUN; QUIT;
```

OBS	SEX	NATION	POK60	PRK60	POK45	PRK45	POK30	PRK30	POBAL	PRBAL
1	F	A	59.0	58	44	41.0	28.0	28.0	27.77	17.88
2	F	A	63.0	66	40	51.0	34.0	31.0	27.05	22.05
3	F	A	60.5	61	39	39.0	24.0	19.0	17.13	14.41
4	F	C	63.0	66	41	39.0	29.0	21.5	16.75	6.78
5	F	C	54.5	50	41	38.0	27.0	28.0	16.00	9.32
6	F	C	58.0	58	39	41.0	24.0	28.0	27.00	9.98
7	M	A	58.0	59	42	42.5	29.0	28.0	26.90	17.65
8	M	C	64.0	68	36	47.0	26.0	28.5	26.40	16.70
9	M	C	59.0	58	45	43.0	30.0	21.0	16.40	15.20
10	M	A	58.0	55	39	49.5	29.0	28.5	17.77	14.90
11	M	C	57.0	55	38	37.0	28.0	28.0	26.74	10.00
12	M	C	62.0	71	45	45.8	31.5	31.0	13.30	12.37

OBS	POHS	PRHS	POLS	PRLS	DIFF1	DIFF2	DIFF3	DIFF4	DIFF5	DIFF6
1	32.0	27.0	23.0	22.0	1.0	3.0	0.0	9.89	5.0	1.0
2	31.5	31.5	19.0	18.0	3.0	1.0	-3.0	5.00	0.0	1.0
3	27.5	26.0	21.0	31.0	0.5	0.0	5.0	2.72	1.5	-10.0
4	28.5	22.0	31.5	11.0	3.0	2.0	7.5	9.97	6.5	20.5
5	32.5	31.0	33.0	31.0	4.5	3.0	-1.0	6.68	1.5	2.0
6	26.0	21.5	.	.	0.0	-2.0	-4.0	17.02	4.5	.
7	67.0	67.5	72.0	60.0	-1.0	-0.5	1.0	9.25	-0.5	12.0
8	57.0	57.0	70.0	52.0	4.0	-7.0	-2.5	9.70	0.0	18.0
9	43.0	40.0	40.0	40.5	1.0	2.0	9.0	1.20	3.0	-0.5

10	64.0	60.0	38.0	38.5	3.0	-1.5	0.5	2.87	4.0	-0.5
11	47.5	41.0	37.0	38.0	2.0	1.0	0.0	16.74	6.5	-1.0
12	44.0	35.0	6.0	5.0	9.0	0.8	-0.5	0.93	9.0	1.0

COMPUTER RESULTS

PAIRED T TEST, TEST ITEM : KINESTHETIC SENSE AT 60 DEGREE

Analysis Variable : DIFF1

N Obs	Mean	Std Dev	T	Prob>|T|
12	2.5000000	2.6371472	3.2839479	0.0073

PAIRED T TEST, TEST ITEM : KINESTHETIC SENSE AT 45 DEGREE

Analysis Variable : DIFF2

N Obs	Mean	Std Dev	T	Prob>|T|
12	0.1500000	2.7612579	0.1881806	0.8542

PAIRED T TEST, TEST ITEM : KINESTHETIC SENSE AT 30 DEGREE

Analysis Variable : DIFF3

N Obs	Mean	Std Dev	T	Prob>|T|
12	1.0000000	4.0898989	0.8469896	0.4150

PAIRED T TEST, TEST ITEM : BALANCE

Analysis Variable : DIFF4

N Obs	Mean	Std Dev	T	Prob>|T|
12	7.6641667	5.4727647	4.851195	0.0005

PAIRED T TEST, TEST ITEM : HAND STRENGTH

Analysis Variable : DIFF5

N Obs	Mean	Std Dev	T	Prob>|T|
12	3.4166667	3.0213884	3.9172986	0.0024

PAIRED T TEST, TEST ITEM : LEG STRENGTH

Analysis Variable : DIFF6

N Obs	Mean	Std Dev	T	Prob>|T|
11	3.9545455	9.0814496	1.4442346	0.1793

VITA

HO-CHENG CHEN

Candidate for the degree of

Master of Science

Thesis: THE EFFECTS OF YANG STYLE OF TAI CHI CHUAN ON SELECTED MOTOR AND PHYSICAL VARIABLES

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