

California State University, San Bernardino

**CSUSB ScholarWorks**

---

Theses Digitization Project

John M. Pfau Library

---

1990

## Effects of dichotic listening on aerobic performance

Frank Zane

Follow this and additional works at: <https://scholarworks.lib.csusb.edu/etd-project>



Part of the [Music Commons](#), and the [Psychology Commons](#)

---

### Recommended Citation

Zane, Frank, "Effects of dichotic listening on aerobic performance" (1990). *Theses Digitization Project*. 561.

<https://scholarworks.lib.csusb.edu/etd-project/561>

This Thesis is brought to you for free and open access by the John M. Pfau Library at CSUSB ScholarWorks. It has been accepted for inclusion in Theses Digitization Project by an authorized administrator of CSUSB ScholarWorks. For more information, please contact [scholarworks@csusb.edu](mailto:scholarworks@csusb.edu).

**EFFECTS OF DICHOTIC LISTENING  
ON AEROBIC PERFORMANCE**

---

**A Thesis  
Presented to the  
Faculty of  
California State University,  
San Bernardino**

---

**In Partial Fulfillment  
of the Requirements for the Degree  
Master of Arts  
in  
Psychology**

---

**by  
Frank Zane  
June 1990**

EFFECTS OF DICHOTIC LISTENING  
ON AEROBIC PERFORMANCE

---

A Thesis  
Presented to the  
Faculty of  
California State University,  
San Bernardino

---


by  
Frank Zane  
June 1990

Approved by:

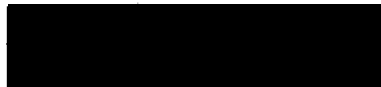


Diane F. Halpern, Chair, Psychology

6/12/90  
Date



Robert Cramer



David Riefer

## ABSTRACT

People of all fitness levels report a problem with regular practice of stationary aerobic exercise, i.e., staying motivated while exercising in order to continue each session long enough for cardiovascular benefits and gradual fat loss. One way to increase exercising time is with the use of a distracting task such as listening to an audio tape. This study compared the effects of dichotic listening (hearing different stories in each ear simultaneously), binaural listening (hearing a single story in both ears), and a control condition (no audio tape) on aerobic performance, which was measured by the amount of time spent riding a stationary bicycle at target pulse rate and total caloric expenditure. Results showed that regardless of order of administration, subjects rode longer and expended more calories when listening to both dichotic and binaural audio tapes compared to a no tape control. There were no significant differences between dichotic and binaural groups indicating that an increased level of complexity of coping style does not enhance aerobic performance. Thus both dichotic as well as binaural listening might effectively be used in recording audio tapes designed for aerobic enhancement.

## TABLE OF CONTENTS

ABSTRACT .....	iii
EFFECTS OF DICHOTIC LISTENING ON AEROBIC PERFORMANCE .....	1
Subliminal Perception .....	2
Hypnotic Induction .....	4
Dichotic Listening .....	7
METHOD .....	13
Subjects .....	13
Apparatus .....	13
Stimulus Materials .....	13
Dependent Measures .....	14
Procedure .....	15
RESULTS .....	17
Table 1 .....	18
Means and Standard Deviations .....	18
DISCUSSION .....	21
APPENDIX: DICHOTIC SCRIPT .....	26
REFERENCES .....	40

## EFFECTS OF DICHOTIC LISTENING ON AEROBIC PERFORMANCE

Aerobics refers to exercise that stimulates heart and lung activity by demanding oxygen without producing an intolerable oxygen debt (Cooper, 1968). Fitness experts recognize the importance of regular practice of aerobic activity for weight loss, cardiovascular fitness (Cooper, 1970), combating psycho-social as well as physical stress (Shulhan, Scher, & Furedy, 1986), and improving psychological well-being (Hayden, Allen, & Cammaione, 1986). Cooper (1970) recommends cycling sessions of ten to thirty-one minutes five times a week for developing aerobic fitness.

One of the problems with the regular practice of aerobics, especially the indoor variety (stationary bicycle, rowing machine, treadmill, and stair climbers) is monotony. Participants often complain that they're not going anywhere and it's boring. This compels many exercise enthusiasts to seek motivational methods such as watching television, reading, or listening to music to combat aerobic boredom while riding a stationary bicycle (Cuerdon, 1990). These methods divide the attention of the participant and cause less attention to be directed to the effort of doing stationary aerobics.

In this case stationary bicycling can be regarded as an automatic process because pedaling becomes highly practiced and requires little or no attention. Since focused attention isn't required to continue the stationary cycling, the effort, provided it isn't too severe, becomes automatized. According to Anderson (1980),

such automatic processes complete themselves without conscious control by the subject.

A decrement in performance can occur during the course of the continuing performance of a dull repetitive task (Schneider, Dumais, & Shiffrin, 1984). It is difficult to remain attentive to a single information source (e.g., stationary bicycling) for an extended period of time if it is not an intrinsically interesting activity or one practiced in a rich environment (Parasuraman, 1984). Since stationary bicycling meets neither of these criteria, it might be made to seem less boring and more enjoyable if a person's attention were divided between the task and a motivational distraction.

Audio tapes can provide such motivational distraction and help immobile riding time pass more quickly (Cuerdon, 1990). They might also serve as a substitute for a personal trainer with the tape giving the exhortations a trainer normally would provide (Zane, Zane, & Glauberman, 1988). Thus audio tapes might help people stay motivated as well as relaxed while doing aerobic exercise to continue long enough to enjoy the benefits associated with cardiovascular fitness. This study focuses on the best way to present audio tapes for maximum aerobic benefits.

### Subliminal Perception

When performance enhancing audio tapes are mentioned, the question often arises as to whether they contain subliminal messages presented below the auditory threshold which bypass conscious awareness. According to Dixon (1981),

both brain and behavior can be affected by the meaning of unconsciously registered stimuli. Henley (1976) showed that homophones presented supraliminally to one ear were influenced by subliminal cue words presented to the other ear in terms of response latencies but not in terms of verbal content. Other evidence exists for the efficacy of commercially produced subliminal audio tapes to influence human performance (Thierfelder, 1989) which suggests that some kind of unconscious semantic processing does occur. Costello (1988) showed increased control of stress management, as subjects using hypnotic subliminal audio tapes were able to relax more deeply. Auditory subliminal perception influenced level of activation as measured in subjects through variations in Mood Adjective Checklist scores. (Borgeat, Chabot, & Chaloult, 1981).

Other studies, however, show that auditory subliminal messages are not effective. Commercially prepared subliminal audio tapes using affirmations masked by ocean waves were ineffective in improving academic achievement (Russell, 1989). Clients of a clinic offering subliminal auditory treatments lost less weight than a clinic which did not offer such treatment (Kurtz, 1986). Subliminal audio tapes did not improve cognitive learning nor motor skills of police recruits (Lenz, 1989). Vokey and Read (1985) found that the apparent presence of backward messages in popular music is more related to active construction by the perceiver than to the existence of the messages themselves. Subjects who believed they heard subliminal suggestions when they actually did not hear them were



affected by this placebo effect and resolved their problems (Nordstrom, 1980). A survey by Block and Vanden Bergh (1985) found consumers to be skeptical about the use of subliminal messages for self improvement and were concerned about being influenced to do something that they did not want to do. In view of the aforementioned controversy concerning the efficacy and ethics of subliminal auditory persuasion, the audio tapes used in the current study contain no subliminal messages.

### Hypnotic Induction

Audio tapes are utilized for self improvement and are often claimed to have a hypnotic effect (Bonnet, 1974; Wood, 1986). Hypnosis has been used in sports to influence relaxation, motivation, exercise tolerance, activity level, performance anxiety, metabolic responses, and motor and psychomotor performance (Jensen, 1989). Hypnotic induction that results in the production of "trance" in the athlete is a common procedure for many sports psychologists (Gordin, 1981; Jacobs, 1984; Pearson, 1983).

Hypnosis refers to the altered state of consciousness produced by the role expectations or preconceptions of the subject, the motivation of the subject by the experimenter's explicit or implicit cues, and the particular technique of trance induction (Orne, 1959). Weitzenhoffer (1957) says hypnotic behavior manifests a constriction of awareness, a characteristic literal mindedness, a degree of automatism, and heightened suggestibility, which can be useful qualities for aerobic activity (Callen, 1983). Although Orne and Weitzenhoffer might not

agree that hypnosis can be supplanted by audio tapes, both Orne's definition of hypnosis along with Weitzenhoffer's explanation of hypnotic phenomena are useful as models for how an audio tape can affect aerobic performance while riding a stationary bicycle. A subject's motivation to perform might be linked more directly to trance induction and/or motivation due to the audio tape itself since the hypnotist is not present to provide the intrinsic and extrinsic cues normally associated with hypnotic induction.

Although there is no universally acceptable physiological criterion for measuring trance, its presence is inferred from observation of the relatively subtle signs manifested by the subject. Some researchers (e.g., Barber, 1976) view hypnosis, the hypnotic state, and trance as unnecessary and misleading constructs and believe that all the phenomena attributed to hypnosis can be produced in normally awake subjects provided they have positive attitudes in the test situation, high motivation to perform maximally, and strong expectancies to elicit unusual behaviors. According to Weitzenhoffer (1953) nearly all, if not all hypnotic phenomena can also occur in the absence of hypnosis or any suggestion. The attitude in the current study is that "hypnosis" provides a convenient label to describe how aerobic improvement might occur.

London (1967) defines hypnotic induction as the entire body of events (verbal inductions are the most common) used for the communication of information from hypnotist to subject to produce hypnosis. The hypnotic state is called trance and is said to be produced when the induction procedure is effective.

A distinction can be made between traditional relaxation induction and active-alert hypnotic induction. These are two completely different ways to induce hypnosis, one employing suggestions of relaxation, the other issuing commands of arousal and alertness.

In a comparison of traditional relaxation induction and active-alert induction, Banyai and Hilgard (1976) obtained results suggesting that a completely active alert hypnotic induction given while a subject pedaled a stationary bicycle produced a state in which all the important characteristics of hypnosis occurred except the resemblance of sleep. The altered state produced by this active-alert induction was characterized by a profound increase in activation and arousal. Even though the subjects seemed to be tiring, they pedaled the bicycle more and more rapidly as they received suggestions of alertness and freshness.

The exercise bicycle used in this experiment employed a level of tension set so high that pedaling required a good deal of effort by subjects that could lead to an intolerable oxygen debt, muscular fatigue, and cessation of aerobic activity before cardiovascular effects were realized. Even though subjects were hypnotized, too much arousal may have been as ineffective as too little arousal for optimum aerobic performance (Krenz, 1984). Just the right amount of arousal necessary to keep the pulse at target heart rate for a period of time long enough for maximum aerobic benefit is needed. Target heart rate is defined by Cooper (1968) as equal to seventy percent of the difference between 220 and a person's age.

Traditional hypnotic induction and stress management techniques involve relaxation. Relaxation training has been shown to be effective in reducing anxiety and increasing athletic performance (Lanning & Hisanaga, 1983; Lanning & Owen, 1982). Stress management training programs improved cardiovascular efficiency in runners (Ziegler, Klinzing, & Williamson, 1982). Since stress and fatigue in training occur frequently, knowing how and when to relax is an important skill for an athlete desiring maximum performance (Serban, 1982).

Klein (1977) described a physiological state called "relaxed wakefulness" that may be conducive for aerobic exercise because it is accompanied by synchronized alpha brain wave rhythms, attention not forced but favoring free association, and good behavioral efficiency characterized by easily executed routine reactions. Relaxed wakefulness is necessary before suggestions can be given successfully to the subject (Glauberman, 1986). Progressive relaxation is a trance induction technique used by Weitzenhoffer (1989). According to Pearson (1983), hypnotherapists develop relaxation in athletes before giving performance enhancing suggestions.

### Dichotic Listening

Bowers and Brennenman (1981) used hypnotic suggestions in a dichotic listening format to induce attentional passivity in subjects. Kahneman (1973) describes the same effects of dichotic listening: "The subjects faced with the overwhelming task of listening to two messages at once realized the futility of any active strategy and usually reported adopting a passive, receptive attitude" (p.

147). This passive receptive attitude induced by dichotic listening may be an ideal state of mind and body to implant suggestions designed to enhance aerobic performance.

Bandler and Grinder (1975) described a double hypnotic induction procedure similar to dichotic listening where subjects received different verbal messages in each ear simultaneously. The messages were given in person by two hypnotherapists and were not continuous phrases as in the dichotic listening tapes used in the present experiment. Matthews, Kirsch, and Moser (1985) showed that a double induction was as effective as traditional single hypnotic induction in producing an altered state of consciousness, but only when the double induction was preceded by the single induction.

Glauberman (1986) produced dichotic listening audio tapes utilizing two stories, metaphorical in nature, both equally complex in meaning and in grammatical structure. Glauberman used paradox (e.g., "feel a heavy weightlessness all through your body"), with selected words from the story in each channel coming together in time to form "embedded commands." Glauberman's embedded commands were relaxation suggestions designed to help evoke the relaxation response (Benson, 1975), since his goal was to reduce stress and deepen relaxation while listening to the audio tapes.

Glauberman's audio tapes borrow from the indirect hypnotic techniques of Milton H. Erickson. Although Erickson never used the dichotic listening format, he did employ metaphors, puns, paradox, ambiguity, analogies, and diversionary

techniques to bypass the subject's conscious frame of reference while the client's "unconscious mind" was processing other patterns of meaning contained in the words (Haley, 1967). Erickson excelled in his ability to intersperse suggestions (i.e., embed commands) by pausing at appropriate times and shifting the tonal quality of his voice to analogically mark suggestions (e.g., "I know that you can **TRAIN HARD** if you would like to.") that would not be perceived by the conscious frame of reference but would be responded to unconsciously instead (Rosen, 1984).

Used in the context of dichotic listening, Ericksonian techniques include occupation of the conscious mind with dual metaphors or stories, one heard in each ear simultaneously, in which the conscious mind tries to follow the literal meaning of either or both stories (Bandler & Grinder, 1975). Each metaphor contains a character who reaches a goal by solving a problem. Inferences drawn from the literature suggest that while the "conscious mind" is trying to follow the literal meaning of the verbal message, the "unconscious mind" is communicated with through the diversionary techniques of paradox, by temporally associating qualities with their opposites, e.g., "strong/gentle," "feeling stronger/relaxing," and "the sound of sunshine," causing the subject to question the meaning (Erickson, Rossi, & Rossi, 1976). Embedded commands or suggestions are interspersed by pausing at appropriate times, thus presenting the subject with homophones -- words pronounced alike but differing in meaning (Kitpatrick, 1985) -- from each story forming suggestive word combinations, e.g., "petal" harder and "road" quickly

(See Appendix). A mild auditory overload is thus created with the subject sometimes listening to one story or the other or both. Given the complexity of this task, it becomes very difficult to listen to everything, so part of the dichotic messages are unattended (Glauberger, 1986).

While listening to a dichotic tape seems to prevent continuous attention to either message, Schaffer and Hardwick (1969) found that subjects did not divide their attention equally, but listened more with one ear than the other. So in the current study, stories were switched to opposite ear channels throughout the dichotic tape making the meaning of the stories more difficult to follow.

Treisman (1971) observed that shadowing (i.e., verbally tracking by repeating out loud) a message that rapidly alternated from ear to ear was more difficult than shadowing a monaural message. Messages from both ears in dichotic listening get into sensory memory and subjects choose certain features for selecting what to attend to. Subjects selecting meaning switched ears to follow the message (Treisman, 1960).

Complexity was further increased in the current study because each story was told by the experimenter in the same voice, making the meaning of each single story harder to follow. Cherry (1953), Cherry and Taylor (1954), and Broadbent (1958) found that shadowing one of two similar messages was poor when the messages differed only in meaning, but not in voice.

Evidence for extensive processing of unattended messages from studies involving dichotic listening suggests that an unattended message is processed so

that semantic meaning is extracted even though the content of the unattended message could not be reported by the subject (Corteen & Wood, 1972; Forster & Govier, 1978; Lackner & Garrett, 1973; Lewis, 1970; MacKay, 1973; Nielsen & Sarason, 1981). Inferences drawn from these studies suggest that subjects seemed to be influenced by the meaning of words in the unattended channel while remaining unaware of them. Thus, it was assumed in the current study that subjects' aerobic performance could be enhanced by messages in the unattended auditory channel that they might be unaware of, especially when the unattended message was motivational as well as relaxing in content.

The effectiveness of dichotic listening audio tape, binaural audio tape, and no audio tape (control or baseline) conditions on aerobic performance were compared as measured by time spent riding at target pulse and calories expended for each condition. It was hypothesized that performance would be enhanced most by the audio tapes and least in the no audio tape condition because the motivational distraction provided by the audio tapes would help stationary riding time seem to pass more quickly to subjects (Cuerdon, 1990). It was further hypothesized that dichotic listening aerobic performance would be significantly better than binaural audio tape aerobic performance. Since the dichotic tape contained more embedded commands and more paradox and complexity because of the two simultaneous inputs, it was expected to have the greatest effect upon increasing individuals' tolerance to boredom and fatigue. It might be similar to two personal trainers instead of one trainer simultaneously exhorting the subject



to elicit a relaxed arousal and enhance aerobic performance by riding longer at target heart rate and burning more calories (Zane, et. al., 1988). Because of its high degree of cognitive complexity, the dichotic tape might transform the repetitive stationary bicycling task into a more interesting activity and prevent a decrement in performance (Parasuraman, 1984; Schneider, et al., 1984).

## METHOD

### Subjects

Twenty-four males and six females with mean age of thirty-four years (range = 29) who were participants in the five day "Zane Experience Program," a private fitness regime, took part in the experiment.

### Apparatus

Equipment used was a Cateye Mate Bicycle Computer Model CC-3000 (using the stopwatch function only), a Cateye Exercise Ergometer Model #EC-1000, and a Realistic Stereo Mate Audio Cassette Player with Aiwa HP M15 Headphones were used to play and listen to the tapes. A Fostex 4 Track Tape Recorder Model X-15 and Audio-Technica Microphone Model PRO 2ax were used to record the audio cassettes. Sennheiser Model HD 430 Headphones and a Modulaire 2250 Stereo Tape Player/Recorder were also used in the recording and the mixdown of the tapes.

### Stimulus Materials

Four short stories, each between ten and eleven minutes long, were written and recorded by the experimenter. Two audio tapes were thus prepared, a dichotic listening tape and a binaural tape.

For the dichotic tape, the "Flower Garden" and the "Leg Train" were recorded consecutively in the left ear channel using track one on the Fostex 4 track tape recorder with mix control on pan extreme left. Next, while listening to

this track in the left ear with Sennheiser Model HD 430 Headphones, the "Bicycle Race" and "Mind Machines" stories were recorded in the right ear channel using track two with mix control on pan extreme right, timing the delivery so that certain words from left and right ear stories came together in time to give embedded commands to the listener, such as "pedal quickly" and "train hard." The master tape thus produced was twenty-one minutes in length and was used in the mixdown to make the final dichotic audio tape as well as the single story binaural tape, both forty-two minutes long. In mixing down the dichotic tape, stories were switched to opposite channels at intervals in the tape (See Appendix), making the meaning of the stories harder to follow. This was done for twenty-one minutes and then the master tape was rewound and remixed with line-out to mixdown tape recorder (Modulaire 2250) reversed which resulted in hearing the same stories but in the opposite ear for the next twenty-one minutes, giving a forty-two minute dichotic audio tape.

The binaural stories were mixed down (with mix control on pan center) one after the other in sequence: Flower Garden, Leg Train, Bicycle Race, and Mind Machines, making the meaning of the stories easy to follow compared to the dichotic audio tape.

### Dependent Measures

The bicycle computer printed out, every thirty seconds, dependent measures of cadence in revolutions per minute, power of pedaling in watts, and pulse in beats per minute. It also printed out total calories expended at the end of each

session on days one, two, and three. On day four in the post-test mode, the subject's age, sex, and weight were put in the stationary bicycle computer. The first minute on the bicycle was spent with subjects not pedaling while the resting pulse was measured. The next nine minutes the subject pedaled at a cadence of 50 to 59 revolutions per minute. The workload increased every three minutes and the maximum physical work capacity (PWC max, the level of exercise attainable at the maximum heart rate) and maximum oxygen uptake (MOU, a measure of volume of oxygen used per unit of time) were measured and physical fitness level (PFL) was assessed in five grades by comparison with the physical fitness level table stored in the computer: 1 = poor, 2 = fair, 3 = average, 4 = good, 5 = excellent (Tsuyama Mfg. Co., 1986).

### Procedure

One experimental condition was administered to subjects riding the stationary bicycle on each of three consecutive days. On day one, subjects were not given an audio tape but were given verbal instructions to start pedaling and to continue pedaling for as long as they liked. This was the control condition. On day two, subjects were randomly assigned to ride while listening binaurally to the single story audio tape or while listening to the dichotic audio tape. Day three was spent riding the bicycle listening to the tape not heard on day two, so that half the subjects heard the tapes in opposite order. Practice and/or fatigue effects were thus controlled by counterbalancing the order of administration of the binaural and dichotic tapes. On all three days, subjects were told they could pedal for as

long as they wanted. Each subject's age, sex, and weight were put into the bicycle computer and used in the automatic mode (which provided proper resistance to keep the subject's pulse at target level) on days one, two, and three. Subjects were instructed not to wear a watch and the computer displays were covered with a towel so that subjects would not receive feedback on their performance. On day four, each subject took a ten minute post-test to determine individual level of aerobic fitness.

## RESULTS

Due to an error by the bicycle computer, scores on MOU and PWC max were obtained for one subject which were obviously too high when compared to other scores of subjects of the same physical fitness level. Simple regression equations were used to replace these outliers (Tabachnick & Fidell, 1989).

Results were then analyzed using a within-subjects design with condition (control, binaural, and dichotic groups) as the independent variable and dependent variables of total time pedaling, total calories expended, and average pulse for each group. The means for each group are presented in Table 1.

Table 1

Means and Standard Deviations

Condition	Dependent measures		
	Pulse (beats/min.)	Time (sec.)	Calories (kcal.)
Control			
<u>M</u>	128.93	1386.37	120.57
<u>SD</u>	11.41	687.86	61.03
Binaural			
<u>M</u>	130.37	2019.47	174.03
<u>SD</u>	7.94	660.34	80.66
Dichotic			
<u>M</u>	131.67	2216.53	181.40
<u>SD</u>	6.23	703.39	84.64

Note. N = 30 for each within subjects group.

Repeated measures analysis of variance for time showed significant differences between conditions,  $F(2,58) = 24.20$ ,  $p < .001$ , with Omega squared = .18. Post hoc Scheffe t-tests revealed that total time was significantly lower in the control condition compared to the dichotic and binaural conditions, with no significant difference between the dichotic and binaural conditions. No significant difference was found for time by order of administration of dichotic tape,  $F(2,56) = .56$ ,  $p = .575$ .

Repeated measures analysis of variance of calories also showed significant differences between conditions,  $F(2,58) = 19.65$ ,  $p < .001$ , with Omega squared = .10. Post hoc Scheffe t-tests revealed that total calories were significantly lower in the control condition compared to the dichotic and binaural conditions, with no significant differences between the dichotic and binaural conditions. No significant difference was found for calories by order of administration of dichotic tape,  $F(2,56) = .80$ ,  $p = .453$ .

Repeated measures analysis of variance for pulse showed no significant difference between conditions,  $F(2,58) = 1.29$ ,  $p = .282$ . No significant difference was found for pulse by order of administration of dichotic tape,  $F(2,56) = .57$ ,  $p = .569$ .

The following significant correlations were shown to exist, each based on 28 degrees of freedom: PWC max and control calories ( $r = .60$ ,  $p < .001$ ), PWC max and binaural calories ( $r = .72$ ,  $p < .001$ ), and PWC max and dichotic calories ( $r = .70$ ,  $p < .001$ ); Maximum Oxygen Uptake (MOU) and control calories ( $r = .50$ ,



$p < .01$ ), MOU and binaural calories ( $r = .55, p < .01$ ), MOU and dichotic calories ( $r = .45, p < .05$ ); Physical fitness level (PFL) and control calories ( $r = .41, p < .05$ ), PFL and binaural calories ( $r = .43, p < .05$ ), PFL and dichotic calories ( $r = .38, p < .05$ ); PWC max and MOU ( $r = .75, p < .001$ ), PWC max and PFL ( $r = .62, p < .001$ ), and MOU and PFL ( $r = .87, p < .001$ ); PWC max and weight ( $r = .53, p < .01$ ), PFL and age ( $r = .42, p < .05$ ); weight and dichotic calories ( $r = .46, p < .05$ ).

## DISCUSSION

Results showed that on the average, audio tapes both dichotic as well as binaural, utilizing Ericksonian techniques of metaphor, paradox, and embedded commands, were effective in improving aerobic performance. The non-significance for pulse was expected since the bicycle computer varied the resistance of pedaling so that each subject would pedal at target pulse. The hypothesized superiority of dichotic listening over binaural listening as a method to enhance aerobic performance was not supported. Relative to the control group, however, dichotic listening was shown to be at least as effective as binaural listening in aerobic performance enhancement, indicating that dividing attention between the riding task and audio tape is a more useful strategy for improving stationary aerobic performance than focusing attention on the riding task alone. Divided attention helped subjects ride longer and therefore expend more calories since attention to external audio tape cues may have attenuated the subjects' perception of boredom and fatigue (Pennebaker & Lightner, 1980).

Listening to the dichotic tape while riding the stationary bicycle is a complex cognitive task compared to listening to the binaural tape. In a study assessing the relationship between cognition and endurance performance (Rejeski & Kenney, 1987) it was questioned whether a more complex dissociative coping style leads to greater endurance than a simple dissociative task. Dissociative coping involves distracting attentional focus from fatigue and has proven effective in increasing

performance time during strenuous exercise (Morgan, Horstman, Cymerman, & Stokes, 1983; Weinberg, Smith, Jackson, & Gould, 1984). The efficacy of cognitive coping in endurance performance (aerobics is a type of endurance performance) is based upon limited channel capacity because available space becomes occupied with the dissociative task. Individuals' tolerance to fatigue increased since they were unable to process distress-related cues simultaneously from sensory inputs. Results of Rejeski and Kenney's study revealed that subjects given a simple cognitive task as well as subjects given a complex cognitive task had greater endurance than those in the control group; however, varying the complexity of the task made no difference. The results of the current study are in agreement with these findings and support information processing theory (Kahneman, 1973).

The significant positive correlations that were shown to exist between control, binaural, and dichotic caloric expenditure and post-test aerobic fitness measures (PWC max, MOU, and PFL, all of which are significantly positively correlated) indicate that the higher one's level of fitness the more calories will be expended in aerobic exercise. Fitness experts such as Cooper (1968, 1970) would agree with this finding which shows that caloric expenditure is increased as one becomes more aerobically fit by regular practice of aerobic exercise over time. Also of interest is the significant positive correlation between weight and dichotic caloric expenditure, which infers that people of higher bodyweights might burn more calories doing aerobic exercise while listening to a dichotic audio tape.

Since it was shown that subjects expended significantly more calories when listening to an audio tape (dichotic or binaural) on the average than when riding the bicycle without listening to an audio tape (177.2 kcal. versus 120.6 kcal), both binaural as well as dichotic audio tapes designed to improve aerobic performance can be a useful adjunct to a fat loss program. According to Garrow (1978), daily consumption of 84 kcal. in excess of energy needs will in one year result in the accumulation of several pounds of extra adipose tissue. Kraus (1971) points out that it takes a caloric deficit of 3500 kcal. to lose a pound of fat. The extra 56.6 calories expended on the average in the audio tape condition could result in a fat loss of up to six pounds a year with daily use of audio tapes while riding a stationary bicycle. Furthermore, audio tapes are inexpensive, and convenient to use and transport since they require only a cassette player and headphones.

Aerobic performance was not significantly different in binaural and dichotic tapes, so it makes sense to use both techniques when recording aerobic audio tapes. When debriefed after the experiment it was apparent that some people seem to prefer one technique to another. Even though the effect of order of administration of the dichotic tape was not significant, it might be more effective to begin recording the audio tape binaurally, as was shown by Matthews, Kirsh, and Moser (1985). This might help to avoid the initial confusion some subjects experienced listening to the dichotic tape. Then recording could switch to dichotic listening, and alternate back and forth with both techniques to take individual preferences into account more effectively.

Since dichotic tapes are much more complex, they might be able to be used for more sessions by adding variety to the aerobic routine of a person who exercises daily. During debriefing when subjects were asked what they remembered of the dichotic tape, they usually remembered very little. They contain more information than binaural tapes and may seem less redundant when used from session to session.

Future research might pay more attention to individual differences in cognitive complexity so that performance task preference (i.e., dichotic or binaural listening while exercising aerobically) might be assessed on a priori basis. Physiological measures such as pulse transit time (PTT) might be used to assess individual differences in mental workload capacity since mental effort lengthens PTT duration (Metalis & Knight, 1990). Suggestibility tests could be given to help ascertain individual differences in susceptibility to embedded commands in the tapes. Dichotic listening tapes containing motivational embedded commands could be compared to dichotic listening tapes that do not contain such commands in order to ascertain their relative influence on aerobic performance. Dichotic listening tapes could be compared to other kinds of audio tapes such as different kinds of music. They might also be compared to binaural tapes for weight-training workout enhancement. Dichotic listening tapes could be recorded for other stationary aerobic activities such as stair climbing and rowing which burn more calories per unit of time than stationary bicycling (Durnin & Passmore, 1967).

Based on the results of this study, not only binaural but also dichotic audio tapes can represent an important contribution to the repertoire of motivational techniques for the individual desiring the benefits of aerobic exercise.

Considering this new application, dichotic listening may be more than just "double talk."

## APPENDIX: DICHOTIC SCRIPT

In recording the dichotic audio tape, the top line is the story heard in the left ear and the bottom line is the story heard in the right ear. Capital letters indicate embedded commands. Asterisks mark the points where the stories cross over to opposite ear channels. In recording the binaural audio tape, the top line story was read all the way through followed by the bottom line story read all the way through.

(Story on the top line is "The Flower Garden")  
(Story on the bottom line is "The Bicycle Race")

The young woman was leisurely walking along the **ROAD**  
The young man was feeling very excited as he **QUICKLY**

through the forest which led to her flower garden.  
ran and hopped on his bicycle. Golden sunlight

Along the way she saw a silver caterpillar **SPINNING**  
reflected off the spokes of the wheels as **THEY STARTED**

its cocoon to change into a butterfly. This is paradise  
to race. As he looked around he felt unsurpassed and

she said to herself. I feel so relaxed and comfortable  
said I will win. This race makes me feel so strong and

in this luxurious garden. It is so peaceful.  
determined. I'm getting so psyched up my energy is

Rose **PETAL** after rose **PETAL** was floating  
growing **QUICKLY.....FASTER** than anyone

through the air. She felt the gentle breeze caressing  
in the entire race. He felt a strong wind pushing hard

her back and it made her want to relax and enjoy even  
on his back and it made him want to concentrate and

.....**MORE** all the beauty of her flower garden.  
**SPEED UP** and ride even faster. As the wind whisked him

There must be a god who created all this beauty  
along he became very deeply engrossed in thought

according to plan she thought and knew she would  
and as his concentration deepened he knew he'd

**ALWAYS** remember all of natures vibrant colors and enjoy  
.....**TRAIN HARD** and continuous and workout according to

more of this wonderful day. More than she had ever  
his plan of winning he loved it so much. Now it was

experienced before. Her **TRAIN** of thought deepened  
time for his training to pay off. **EVEN HARDER** was it

as she heard her heartbeat and began to concentrate on  
not to be drawn into his deep focus on winning and he

and wonder about its deepening rhythm and silently  
found himself becoming hypnotized as he heard clearly

watched with complete attention golden rays of sunshine  
and reflected on the sound of his feet whirling round

illuminating and enlightening the mixture of sensual  
pedaling quickly revolving over and over in his ears.

delights in her beautiful flower garden which became  
He couldn't believe how wonderful this feeling was

magnified before her very eyes. **IT WAS**  
the most amazing sensation and most **POWERFUL**

something to behold. wonderful fragrances arose which  
he ever felt and as he continued to rhythmically go

filled the air and began spreading.....**QUICKLY**  
round, round, and round and **PEDAL HARD**

In the garden of beautiful violets, roses, tulips, and  
keeping way in front of the pack of bicycle racers

chrysanthemums. The sweet essence of **A ROSE**  
which made him keep up his fast pace. **SUCCESS**



and a gardenia were her favorite smelling flowers and was on his mind and he could imagine himself smelling

and she loved the shapes and colors of the violets, the flowers of the winners wreath. This indeed was the

tulip, and chrysanthemums as well. She was enjoying a sweet smell of success.....This thought

delightful **FEELING** of deep relaxation, deeper than made him **STRONGER** as he came to a steep hill and began

ever before. And she felt that being in her garden on began climbing the mountain road which lay before him.

beautiful days like this was so satisfying The air was filled with aromas of pine trees. He could

**A SENSATION OF PLEASURE**  
**FEEL SUCH EXHILARATION**

that she was totally **ABSORBED\*** in the sights and as he became entirely **ABSORBED\*** in the sounds and

smells of her beautiful flowers. sensations of his rhythmic breathing.

She could feel her heartbeat slow down as she smiled His entire body and brain were resonating in a

and heard a bird singing an enchanting melody and saw harmonious frequency as he reached the top of the mountain.

a red rose **PETAL** on her sweater. A warm tingling He felt energized **MORE AND MORE** as he began to realize.

spread through her body and this delighted her immensely. just how far ahead he was. He would be a great winner.

So she sat down in her favorite spot and gazed **UP** So he stood up on his bicycle and increased his **SPEED**

at the patches of billowy white clouds drifting so much that he entered a pedaling trance and felt

gracefully through the sky. As she watched the fluffy  
he was actually flying faster and faster in a racing

white clouds she could see their silver lining and  
style all his own. He started downhill and his pulse

she felt like she were floating along with them  
quicken as he accelerated even more thrusting himself

**FLYING** through the air drifting gracefully,  
**FASTER AND FASTER** and felt a force take him over

she closed her eyes and totally imagined she was in  
pushing him beyond sixty miles an hour before he even

some far away galaxy, millions and millions of light  
realized it. This was faster than he had ever rode

years above the earth. She was mentally flying through  
before and as he kept up his ultra fast pace, he heard

space faster than the speed of light. What a great  
himself saying: I am now racing at well over a mile

time I'm having. **I'M SO HIGH**  
a minute .....**FROM EXERCISING**

and I know that I will always cultivate this  
at this rate I know that I will set a new

**GOOD FEELING** that happens every time I come here  
world **SPEED** record. I am certain of this

she said to herself and drifted off into  
he said to himself as he sped along the road

deep, deep, relaxation. She was in-trance-d  
far ahead of everybody. He was in-trance-d

as she plunged deeper and deeper down, into the depths  
by the wind whistling in his ears, and as he continued

of the collective unconscious.....**I AM**  
going faster and faster and was actually **ACCELERATING**

meeting all these archetypes and its fascinating  
as he rounded a curve. The harder I pedal the easier

to explore my psyche. I especially love my animus  
it gets. He could see the finish line in the distance

and enjoy getting in touch with the man in me  
It's all downhill from here and I know I will win

for it gives me an inner strength she said to herself  
because I will pace myself and concentrate and say

as she continued meeting archetype after archetype.  
only the most positive things to myself and make sure

Drifting even deeper down as she slept a rose **PETAL**  
that I know when to push hard and go all out **HARD&FAST**

floated through the air as the delicate aromas of  
at exactly the right time.....I love to

violets and a chrysanthemum **PETAL**  
ride hard on my bicycle **QUICKLY**

permeated the depths of her very **BEING.**  
like this and I certainly feel as **STRONG NOW**

These fine scents resulted in dream images even  
as I did at the beginning of the race. It must be the

**MORE** beautiful marvelous interesting and  
**TRAINING** along with the good nutrition I get from

wonderful an experience.....**THAN BEFORE**  
delicious meals plus I **KEEP TRAINING HARDER**

This is more than ordinary reality. I know I **MUST**  
at all times in order that I will **REACH MY GOAL.**

be dreaming, and since this is my dream I **AM**  
I know I can do it makes me feel strong and **ENERGETIC**

positive I can do whatever I want, and I **CAN**  
and I'm certain I will always **FEEL CONFIDENT**

invent my future just by dreaming it. I can **RECOVER**  
of myself and my performance as well. I am now **COMPLETELY**

and remember all the pieces of my dream, as I pass  
convinced that my dream of winning is true, and know

through the zone between sleeping and waking.  
that by constantly keeping this in mind I will maximize

Knowing that she would always remember this thought  
my potential. With that thought in mind up went his

she woke up and felt the wind blowing on her gently  
speed so much in no time at all that he actually

as she glanced at a rose **PETAL** floating downward  
accelerating even much **MORE QUICKLY** than before

through the air and this brought a smile to her face.  
across the finish line, winning easily another race.

The young woman had read about the brain, the mind, and  
The news of his victory would be in sports magazines

dreaming, so she knew she was having a lucid dream.  
and would be read by many people around the world.

Opening her eyes **SHE FELT GOOD ABOUT HERSELF\*** and  
This thought made **HIM FEEL GOOD ABOUT HIMSELF\*** and

noticed a bird **FLYING** in the sky with a note attached  
he saw a plane **FLYING** in the sky pulling a sign that

to its wing that said: The exhilaration and excitement  
said: The euphoria of winning is a wonderful feeling

you feel will increase even more as you continue  
that keeps getting better and better with each

thinking **UPLIFTING THOUGHTS**. And as she read the note  
**EXPERIENCE**. And as he was reading the sign

she intuitively felt deep down that she would be able  
he felt deep down inside that he had the strength and

to **RELAX** **CONTINUOUSLY**  
energy to **KEEP PEDALING** **SO QUICKLY**

in her own unique way whenever she desired.  
and easily like this to wherever he wanted.

With this thought in mind she got up and walked around  
So he kept riding his bicycle because by this time he

in her flower garden and knew that she would remember  
felt a force flowing through him that was pedaling him

this wonderful day for a long time. And as she looked  
And he knew that this force would enable him to ride

up the **ROAD** she saw bicycle riders in the distance  
ride **REALLY FAST** for as long as he wanted. I love

coming toward her. They were talking and laughing and  
riding so much that I'm going to turn around and ride

enjoying themselves and there were billowy white puffs  
back to the starting line because it seems that this

of smoke coming from a distant **TRAIN** traveling  
particular bicycle race wasn't long or **HARD** enough

in the mountains which surrounded her garden. And the  
for me. So he called out to the other riders: Will

sight of this reminded her of her childhood, when she  
you join me and ride back to the starting line?

used to ride her tricycle through the flower garden  
We will join you because we still have lots of energy

And she could almost feel rose **PETAL** after rose **PETAL**  
to spare and we know we can go **FAST** like you **EASILY**,

drifting and floating through the air. And this feeling  
they answered. And so they continued riding together.

of deep deep relaxation would stay with her  
in rhythmic cadence at just the right pace

for a **LONG LONG TIME.**  
for a **LONG LONG TIME.**

(The top line story is "The Leg Train")  
(The bottom line story is "The Mind Machines")

**AND AFTER A WHILE** the young man and the pack of  
**AND AFTER A WHILE** the young woman came out of her

bicycle riders came upon a very wise man who was also  
flower garden and knew she was ready to start to

a locomotive conductor. While riding on his **TRAIN**  
improve and develop her body. She was very **QUICK**

one day the man would get an idea. People are  
mentally and as she walked by the gym one day,

not satisfied with their bodies and are **IN NEED OF**  
she saw men and women using weights **TRAINING HARD**

fitness and they want to improve their appearance  
sweating a lot. There must be an easier way to improve

so why not ride and run a gym on wheels. **TRAIN**  
my body. I think I will make progress much **FASTER**

wheels he said to himself as he sped along the tracks  
if I lift lighter weights and do more repetitions.

and blew his whistle. I will transform my train  
And as she wondered what variety of training she

and install leg training equipment **MYSELF**  
would do, she saw a sign on a **BUILDING UP**

in every cabin. And it wasn't long before people  
on top that said: The mind gym. Develop your body/mind

on his route found out about the leg **TRAIN**  
while relaxing. That's fascinating. **YOUR BRAIN**

The very first morning as the train filled with people  
can train too, she thought. I can use my mind to develop

on their way to **WORK**, they noticed that their seats  
my body. As she walked **OUT** into the mind gym she found

on the leg train had been replaced by sculptures  
some very interesting brain training devices. The

designed for leg work. As they stared, **MESMERIZED\***  
first was a box of mirrors and she was **MESMERIZED\***

by the sight of the sculptures wondering why their  
as she stepped inside and saw hundreds of images of

seats had disappeared, a voice began speaking over  
her body from every angle. So this is what I really

the loudspeaker: I'm Frank Zane and you are passengers  
look like. I am becoming aware of how my body is

on my leg **TRAIN**. Listen to me. This **TRAIN**  
changing **QUICKLY**....and it's not that **HARD**.

makes no stops until it reaches your final destination,  
She came out of the chamber of mirrors and saw

**RHODE** Island. I am taking you to a community of great  
**QUICKLY** a mind machine shaped like a large egg.

legs in order to show you what is possible for you to  
She climbed into the egg and floated on top of a

achieve for yourself. You see, I've been **TRAINING**  
membrane filled with ocean saltwater. I **FEEL LIKE**

my legs very hard on a regular basis. so I **WILL GET**  
I am floating on a cloud she said as ions **PUMPED**

the best legs on anyone my age, and I'd just like to  
through the inside of the egg. It was like a cool

encourage you so that you can have the best legs of  
breeze gently caressing her entire body, and as she

your life as well. So you can start now to **TRAIN**  
relaxed in deep comfort she found it wasn't **HARD**

Island. It's a long trip but as long as you continue to develop a great body if you train intelligently.

to use the leg train equipment, the trip will pass This means that you should train hard enough to

very **QUICKLY**. So the trainees got ready for **GET** **A GREAT PUMP** and know when to stop so you

their leg workout and after first doing leg extensions don't overtrain. And you must train mentally as well

they began to do **DEEP\*** knee bends with the leg train and this is what **DEEP\*** relaxation is all about.

equipment. With the **EXERCISE** their hands were free So she relaxed **RHYTHMICALLY** and listened

and they could hold on to the sculpture and squat deep down inside as her mind filled with positive

fully and completely into rock bottom position. affirmation she kept saying to herself.

I will always **TRAIN HARD** like this, one young man said I always **LOVE TO** hear stories that are relaxing

to himself. I **FEEL** well balanced and there's no and make me **MOTIVATED** at the same time.

strain on my lower back and knees yet my thighs are Deep relaxation and motivation are important aspects

getting a pump like never before. I really love of training my body and mind, but I didn't expect to

this **EXERCISE**. And so they all did full erect deep relax so **QUICKLY** like this. The next day she returned

squats for three sets of twenty repetitions and to the mind gym to begin her mental power program.

they were breathing **HARD** when they finished. It makes sense to **TRAIN** my brain she thought.



This exercise must have an aerobic effect on my body.  
Brainwork is how the mind in bodybuilding really works.

I feel cardiovascular effects like never before,  
Now I'm going to think of my brain as a body part and

a beautiful young woman said to herself as the leg  
train it every day. Like muscle, it grows in the sense

**TRAIN** entered a stormy section of a mountain pass.  
it **QUICKLY** defines new pathways with each new method

She could see lightning and hear thunder and feel the  
I learn. So she climbed into the cosmic egg and

rain all over the surface of her entire body, making  
drifted off into deep, deep relaxation and caught a

her excited and strong yet refreshed as everyone began  
glimpse of her perfect future body: her calves.....

\*supersetting leg curls with lunges, doing three sets  
\*frontal thighs....leg biceps....hips....and waistline

of 12 repetitions increasing the weight on every set.  
and her upper body as well. And as she visualized her

of each **EXERCISE**. As they finished their thigh  
ideal body she **QUICKLY** felt a subtle electric current.

workout each person felt swell sensations **TAKE** over  
flowing through her body, giving her a real **CHARGE**.

their bodies and **BECOME MORE INTENSE**. I can't believe  
What I really want **IN MY WORKOUT** is imagination, she

the workout I'm getting they said to themselves as they  
thought as she left the egg. So she started training

kept pushing hard on the standing calf raise. After a  
and the next day she was back in the egg again. This

short time their calves began pumping like never before  
time she wore goggles which pulsed with soothing

as they all did three sets of 20 reps **INCREASING** the golden lights and as she changed **THE FREQUENCY**

intensity on each and every set. What a burn I'm getting just by pressing a button. With her eyes closed she saw

a young bodybuilder yelled out on his very last repetn. pleasing images and learned the best frequency for

I know I will be able to develop my calves to unbeliev- deep relaxation was delta waves of 1 to 3 cycles per

able dimensions and proportions as I keep training second, while the best frequencies for visualization

hard like this. Next they sat on each others backs were theta waves of 4 to 7 cycles per second. While

and did 3 sets of 20 donkey calf raises supersetted the lights flashed a subtle relaxing tone and the

with seated calf raises and finished their leg sound of the ocean played into her ears and it wasn't

**WORKOUT.** A cool breeze began blowing through the **HARD** to listen to great symphonies and find that

windows refreshing them as the leg train climbed the each piece had its own best frequency. Mozart was most

mountain making the final ascent to the **RHODE** Island enjoyable at delta frequencies while Bach was **MORE**

community. As they stepped off the leg train their legs stimulating at theta brain wave frequency. So she

still felt pumped and each of them noticed a spring in experimented training her brain using the system called

their **STEP UP** as they leisurely strolled through the **FREQUENCY** following response. Arising from sleep

landscapes of this training paradise, they discovered each morning she entered the cosmic egg and tuned in

centered in **RHODE** Island was a magnificent park and her brain waves **EASILY**. My body repairs itself during

the conductor was waiting to greet the trainees as slow wave or stage 4 sleep by secreting growth hormone

they arrived. **YOU ARE WELCOME** in this land of great and I'll be able **TO PRODUCE MORE** growth hormone by

legs the conductor said to the crowd. All the people spending an extra half hour each day engulfed in delta

of this community have great legs and they all arrived brain waves she said to herself. I am also more

on the leg **TRAIN**. Now that you are here, you can have creatively **ENERGIZED** when I tune into theta waves

great legs too for you've experienced the best way to before my workout. And she found herself much more

work them. You can train as long as you like in our deeply relaxed and continued to use the mind machines.

leg **TRAINING** paradise. After the conductor had finished My body **QUICKLY** improves beyond belief with my new

his talk, he took them on a tour through the park intelligent training and so is the way I think, feel,

and although there were many pieces of leg and act, she said to herself. Now that I am

**TRAINING** equipment, the trainees noticed that **COMPLETELY RELAXED**, I will create and practice a very

all the people used the leg train equipment more than special training program just for me. And she saw

anything else, for they knew that fully erect deep herself doing perfect repetitions in a flawless style

squats and calf raises were the foundation of great that had a rhythm all its own. So she continued to

leg development. So they continued doing the **EXERCISE**  
watch the perfect image of herself **AT PEAK PERFORMANCE**

they learned on the leg **TRAIN** and their legs kept  
and pushed herself just **HARD** enough to maximize her

getting better and better and so did the way they  
potential. And she found out that her mental power

thought, felt, and behaved. By now the conductor had  
worked. And when she combined weight training exercise

spent a **LONG TIME** training his legs and one of his  
with **RIDING** her bicycle she found this to be

favorite exercises for defining the thighs was **RIDING**  
the most effective ever. And her gains came **FASTER**

his bicycle for a long time every day. So he said to  
and faster as her strength continued to build along

his passengers, I know you'll improve your leg  
with her endurance. This combination when done for a

development and build your endurance the longer you  
good amount of time every day developed a sense of

continue to practice **RIDING** your bicycle. And from  
of accomplishment **VERY QUICKLY** in her that she had

that moment on they knew that they would stay in  
never known before. And she knew deep down inside that

Rhode Island and continue to train hard  
she would develop a fabulous body and train

**FOR A LONG LONG TIME.**  
**FOR A LONG LONG TIME.**

## REFERENCES

- Anderson, J. R. (1980). Cognitive psychology and its implications. New York: Freeman.
- Bandler, R., & Grinder, J. (1975). Patterns of the hypnotic techniques of Milton H. Erickson, M. D. (Vol. 1). Cupertino, Ca.: Meta Publications.
- Banyai, E. I., & Hilgard, E. R. (1976). A comparison of active-alert hypnotic induction with traditional relaxation induction. Journal of Abnormal Psychology, 85, 218-224.
- Barber, T. X. (1976). Hypnosis: A scientific approach. New York: Psychological Dimensions.
- Benson, H. B. (1975). The relaxation response. New York: Morrow.
- Block, M. P., Vanden Bergh, B. G. (1985). Can you sell subliminal messages to consumers? Journal of Advertising, 14(3), 59-62.
- Bonnet, E. B. (1974). The utilization of audio tapes in hypnosis. Journal of the American Institute of Hypnosis, 15(2), 82-87.
- Borgeat, F., Chabot, R., Chaloult, L. (1981). Subliminal perception and level of activation. Canadian Journal of Psychiatry, 26(4), 255-259.
- Bowers, K., & Brennenman, H. A. (1981). Hypnotic dissociation, dichotic listening, and active versus passive modes of attention. Journal of Abnormal Psychology, 90(1), 55-67.
- Broadbent, D. E. (1958). Perception and communication. London: Pergamon Press.
- Callen, K. E. (1983). Auto-hypnosis in long distance runners. Journal of Clinical Hypnosis, 26(1), 30-36.
- Cherry, E. C. (1953). Some experiments on the recognition of speech with one and two ears. Journal of the Acoustical Society of America, 25, 975-979.
- Cherry, E. C., & Taylor, W. K., (1954). Some further experiments upon the recognition of speech with one and two ears. Journal of the Acoustical Society of America, 25, 554-559.

- Cooper, K. H. (1968). Aerobics. New York: Bantam.
- Cooper, K. H. (1970). The new aerobics. New York: Bantam.
- Corteen, R. S., & Wood, B. (1972). Autonomic responses to shock associated words in an unattended channel. Journal of Experimental Psychology, *97*, 308-313.
- Costello, B. R. (1988). Assessing progress of two therapy sessions using Budzynski relaxation tapes. Journal of Instructional Psychology, *15*(2), 47-50.
- Cuerdon, D. (1990, February). Stationary psychling: 10 ways to have fun riding indoors without really having fun. Bicycling Magazine, pp. 80-83.
- Dixon, N. F. (1981). Preconscious processing. New York: Wiley & Sons.
- Durnin, J. V., & Passmore, R. (1967). Energy, work and leisure. London: Heinemann.
- Erickson, M. H., Rossi, E. L., & Rossi, S. I. (1976). Hypnotic realities. New York: Wiley & Sons.
- Forster, P. M., & Govier, E. (1978). Discrimination without awareness? Quarterly Journal of Experimental Psychology, *30*, 282-95.
- Garrow, J. S. (1978). Energy balance and obesity in man. New York: Elsevier North-Holland.
- Glaubergerman, L. (1986, October). Hypno-peripheral processing: The evolution of a concept. Paper presented at the meeting of the Floatation Tank Association, Miami, Fl.
- Gordin, R. D. (1981). Effects of hypnosis, relaxation training, or music on state anxiety and stress in female athletes (Doctoral dissertation, University of Utah, 1981). Dissertation Abstracts International, *42*(2-A), 598-599.
- Haley, J. (1967). Advanced techniques of hypnosis and therapy: Selected papers of Milton Erickson. New York: Grune & Stratton.
- Hayden, R. M., Allen, G. J., & Cammaione, D. N. (1986). Some psychological benefits resulting from involvement in an aerobic fitness program from the perspectives of participants and knowledgeable informants. Journal of Sports Medicine and Physical Fitness: Quarterly Review, *26*, 67-76.

- Henley, S. H. A. (1976). Responses to homophones as a function of cue words on the unattended channel. British Journal of Psychology, 67(4), 559-567.
- Jacobs, S. B. (1984). The effects of post-hypnotic performance-enhancing instructions on cognitive-motor performance (Doctoral dissertation, University of South Carolina, 1984). Dissertation Abstracts International, 45/09B, 3073.
- Jensen, R. J. (1989, August). Hypnosis and sport psychology: Possibilities for research and applications. Paper presented at the meeting of the American Psychological Association: New Orleans, Louisiana.
- Kahneman, D. (1973). Attention and effort (pp. 147-148). Englewood Cliffs, N.J.: Prentice-Hall.
- Kitpatrick, J. J. (1985). The ear is human: A handbook of homophones and other confusions. Kansas City, Ks.: Andrews, McMeel & Parker.
- Klein, D. B. (1977). The unconscious: Invention or discovery. Santa Monica, Ca.: Goodyear.
- Kraus, B. (1971). Calories and carbohydrates. New York: Signet.
- Krenz, E. W. (1984). Improving competitive performance with hypnotic suggestions and modified autogenic training: case reports. American Journal of Clinical Hypnosis, 27(1), 58-63.
- Kurtz, R. S. (1986). Subliminal messages for weight loss: effectiveness and satisfaction. Masters Abstracts, 26(1), 159.
- Lackner, J. R., & Garrett, M. F. (1973). Resolving ambiguity: effects of biasing context in the unattended ear. Cognition, 1, 359-374.
- Lanning, W., & Hisanaga, B. (1983). A study of the relation between the reduction of competitive anxiety and an increase in athletic performance. Journal of Sport Psychology, 14(4), 219-227.
- Lanning, W., & Owen, H. (1982). Effects of three treatment methods upon anxiety and inappropriate attentional style among high school athletes. Journal of Sport Psychology, 13(3), 154-162.
- Lenz, S. (1989). The effect of subliminal auditory stimuli on academic learning and motor skills performance among police recruits. (Doctoral dissertation,

California School of Professional Psychology, Los Angeles, 1989).  
Dissertation Abstracts International, 50/07-B, 3165.

- Lewis, J. (1970). Semantic processing of unattended messages using dichotic listening. Journal of Experimental Psychology, 85, 225-228.
- London, P. (1967). The induction of hypnosis, in Gordon, J. E. (Ed.), Handbook of Clinical and Experimental Hypnosis. New York: MacMillan.
- Mackay, D. G. (1973). Aspects of the theory of comprehension, memory and attention. Quarterly Journal of Experimental Psychology, 25, 22-40.
- Matthews, W., Kirsch, I., & Moser, D. (1985). Double hypnotic induction: An initial empirical test. Journal of Abnormal Psychology, 94(1), 92-95.
- Metalis, S. A., & Knight, T. M. (1990, April). Pulse transit time and mental workload. Poster Session, Western Psychological Association Convention, Los Angeles, Ca.
- Morgan, W. P., Horstman, D. H., Cymerman, A., & Stokes, J. (1983). Facilitation of physical performance by means of a cognitive strategy. Cognitive Therapy and Research, 7, 251-264.
- Nielsen, S. L., & Sarason, I. G. (1981). Emotion, personality, and selective attention. Journal of Personality and Social Psychology, 41(5), 945-960.
- Nordstrom, R. R. (1980). The placebo effect, subliminal perception, and hypnotic induction. Hypnosis Quarterly, 23(3), 9-12.
- Orne, M. (1959). The nature of hypnosis: artifact and essence. Journal of Abnormal and Social Psychology, 58, 277-299.
- Parasuraman, R. (1984). Sustained attention in detection and discrimination. In R. Parasuraman, & D. R. Davies (Ed.), Varieties of Attention (pp. 243-271). Orlando, Fl.: Academic Press.
- Pearson, P. (1983). Practical applications of hypnosis in sporting performance. Australian Journal of Clinical Hypnotherapy and Hypnosis, 4(1), 13-19.
- Pennebaker, J. W., & Lightner, J. M. (1980). Competition of internal and external information in an exercise setting. Journal of Personality and Social Psychology, 39(1), 165-174.



- Rejeski, W. J., & Kenney, E. (1987). Distracting attentional focus from fatigue: does task complexity make a difference? Journal of Sport Psychology, 9(1), 66-73.
- Rosen, W. (1984). The psychotherapeutic and hypnotherapeutic approaches of Milton H. Erickson. American Journal of Psychoanalysis, 44(2), 133-145.
- Russell, T. G. (1989). The effect of subliminal auditory messages upon academic achievement. (Doctoral dissertation, University of Oklahoma, 1989). Dissertation Abstracts International, 50/06-B, 2609.
- Schaffer, L. H., & Hardwick, J. (1969). Monitoring simultaneous auditory messages. Perception & Psychophysics, 6, 401-404.
- Schneider, W., Dumais, S. T., & Shiffrin, R. M. (1984). Automatic and control processing and attention. In R. Parasuraman & D. R. Davies (Ed.), Varieties of attention (pp. 1-27). Orlando, Fl.: Academic Press.
- Serban, M. (1982). Psycho-physical relaxation: a method of training and improving. Educatie Fizica si Sport 35(1), 55-59. (From Psychological Abstracts, 1982, Abstract No.1 134327).
- Shulhan, D., Scher, H., & Furedy, J. J. (1986). Phasic cardiac reactivity to psychological stress as a function of aerobic fitness level. Psychophysiology, 23(5), 562-566.
- Tabachnick, B. G., & Fidell, L. S. (1989). Using multivariate statistics. New York: Harper & Row.
- Thierfelder, W. K. (1989). The effect of subliminal auditory stimuli on reaction time, heart rate, electrodermal response, and word recognition speed. (Doctoral dissertation, Boston University, 1989). Dissertation Abstracts International, 50/11-A, 3536.
- Triesman, A. M. (1960). Contextual cues in selective listening. Quarterly Journal of Experimental Psychology, 12, 242-248.
- Triesman, A. M. (1971). Shifting attention between the ears. Quarterly Journal of Experimental Psychology, 23, 157-167.
- Tsuyama Mfg. Co. (1986). Cateye operating instructions Model EC - 1000. Osaka, Japan.

Vokey, J. R., & Read, D. J. (1985). Subliminal messages: between the devil and the media. American Psychologist, 40(11), 1231-1239.

Weinberg, R. S., Smith, J., Jackson, A., & Gould, D. (1984). Effect of association, dissociation, and positive self-talk strategies on endurance performance. Canadian Journal of Applied Sport Science, 9, 25-32.

Weitzenhoffer, A. M. (1953). Hypnotism: An objective study in suggestibility. New York: Wiley & Sons.

Weitzenhoffer, A. M. (1957). General techniques of hypnotism. New York: Grune & Stratton.

Weitzenhoffer, A. M. (1989). The practice of hypnotism: Traditional and semi-traditional techniques and phenomenology (Vol. 1). New York: Wiley & Sons.

Wood, A. V. (1986). Hypnosis and audio tapes as a treatment for agoraphobia. Australian Journal of Clinical Hypnotherapy and Hypnosis, 7(2), 100-104.

Zane, C. E., Zane, F., & Glauberman, L. (Speakers). (1988). Thinking thin feeling fit audio cassette program. New York: Baer Tracks Recording Studio.

Ziegler, S. G., Klinzing, J., & Williamson, K. (1982). Effects of two stress management training programs on cardiorespiratory efficiency. Journal of Sport Psychology, 4(3), 280-289.