156 - THE MENTAL TRAINING INFLUENCE IN STRENGTH GAINS AFTER FOUR WEEKS OF PRACTICE

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INTRODUCTION

Mental training can help in the performance without the pressure of the ability gains with physical training (SOUZE & SCALON, 2004). In practice it consists of mentally repeating an imagined movement many times with the intention to improve motor performance (JEANNEROD, 1994). Imagining a road trip, the image corresponds to a dynamic state during the representation of a specific action reactivated internally inside the memory (JACKSON *et al., 2001;* DECETY & GRE`ZES, 1999). These studies had shown that mental practice of a specific task generates less improvement than that of real physical activity, even so mental practice leads to a superior performance increase when compared with a condition of no practice (FELTZ & LANDERS, 1983). Mental representation of yourself can be generated in two types; inside (kinesthetic) images and outside (visual) images, what represents a perspective of the action (DEIBER *et al, 1998;* RUBY e DECETY, 2001). New researches shows evidences that mental practice can activate brain sites similar to the ones activates during real physical activity (STEPHAN *et al*., 1995; LAFLEUR *et al*., 2002).

There are evidences about increase on dynamic muscular strength (ELKO & OSTROW, 1992; GOULD *et al*., 1980; SHELTON & MAHONEY, 1978; THEODORAKIS *et al.,* 2000; TYNES & MCFATTER, 1987; WEINBERG *et al.,* 1981; WHELAN *et al*., 1990; WILKES & SUMMERS, 1984; TOD *et al*., 2005), endurance (CAUDILL & WEINBERG, 1983; LEE, 1990; WEINBERG *et al*., 1985) and power (CAUDILL & WEINBERG, 1983; LEE, 1990; WEINBERG *et al*., 1985). Others articles, in the other hand, didn't present increases at the results (BRODY *et al*., 2000; TENENBAUM *et al*., 1995; THEODORAKIS *et al*., 2000; MURPHY *et al*., 1988).

The purpose of this investigation is to verify if mental training helps to increase muscular strength after four weeks of training.

MATERIALS AND METHODS

Subjects

Twenty eight healthy male volunteers, age between eighteen and thirty years old. All of them had experience in strength training, had been practicing for a minimum of six months tree days a week, and were free of injury.

Testing procedures

Participants where randomly selected for the one repetition maximum bench press test (1RM). The warm up consisted in ten repetitions with approximately 50% of their 1-RM first try. They were encouraged to perform their best to complete 1-RM. After five minutes they had another trial with more weight if they were successful or less weight if they had failed. The best result was taken after of five trials in maximum. Participants had the same test for tree days with forty eight hours rest interval between them. The average of these trials was retained as representative result. The same investigator during all tests judged successful 1-RM attempts.

Intervention

Subjects were separated in two randomized groups of fourteen subjects, (G1) heavy resistance training and (G2) heavy resistance and mental training. Both groups had the same heavy resistance training. The protocol consisted in tree sets of four maximum repetition using 90% of 1-RM and tree minutes interval between sets (KRAEMER & HAKKINEN, 2004). Weight training was performed for four weeks, tree days a week. After two weeks all subjects had 5% increased on their training loads. Subjects in G1 and G2 were individually supervised by the investigator to ensure that all essential program characteristics were strictly enforced.

For mental training G2 was instructed to simulate mentally the bench press movement before beginning the exercise and during the interval series. That visualization of yourself doing exercise is called mental imagery (FELTZ, 1983).

Results

The G1 and G2 pretest results were submitted to an independent samples t test to verify the equality of the means and the Levene test for the equality of error of the variances.

TABLE 1: Comparing the G1 and G2 pre-tests

						Levene's test		t test		
	Group	n	Mean	Stantard deviation	Standard error of the mean	F	*p*	t	gl	*p*
Pre-test 1-RM	1	14	86,4	17,21	4,60	2,242	0,15	0,097	26	0,92
	2	14	87,1	21,56	5,76					

The equality of the means and the variations between groups was proved by the t test and Levene's ($p > 0,05$). So, the groups, that were randomly sampled from a same population, were not affected by chance, because there was no significant difference between the means, and the homocedasticity of their variances was proved.

TABLE 2: Descriptive statistics for G1 and G2 at pre-test and test of 1-RM

	Group	*Mean*	*Standard deviation*	*n*
Pre-test 1-RM	1,00	86,4286	17,2078	14
	2,00	87,1429	21,5616	14
	Total	86,7857	19,1454	28
Teste 1-RM	1,00	91,0714	17,8475	14
	2,00	95,2143	22,2751	14
	Total	93,1429	19,9178	28

Group 1: resistance training
Group 2: mental imagery and resistance training

Analyzing the mean values, it is noticeable an elevation of them after the training is applied. However the deviations are still similar.

Either resistance training applied to Group 1 (G1), or resistance training associated to mental imagery applied to Group 2 (G2) generated significant improvements, when dependent t test was applied to compare the pre-tests to tests results for each group.

TABLE 3: Dependent samples t test

	1-RM G1 Pre-test	*1-RM G1 Test*	*1-RM G2 Pre-test*	*1-RM G2 Test*
Mean	86,4	91,1	87,1	95,2
Variance	296,11	318,53	464,90	496,18
n	14	14	14	14
Pearson's correlation	0,996		0,996	
Means difference hypothesis	0,05		0,05	
gl	13		13	
t statistic	-10,669		-15,06	
***p* (two-tailed)**	**0,00000008**		**0,000000001**	
Critical t (two-tailed)	2,16		2,16	

Now, it must be verified if the resistance training associated to mental imagery achieved higher percentages of improvement than those found in group 1 which performed only the resistance training. The percentage of improvement for each subject was calculated applying the following formula: % of improvement = ((test x 100) / pre-test) - 100

The Levene's test evidenced that percentage of improvement variances from the two groups did not differ significantly. So, independent Student's t test, presuming equal variances was adopted. Through the t test it was verified that the means difference was significant (p = 0,0001), inferring that resistance training associated to mental imagery gives significant muscular strength improvement, rather than resistance training alone.

TABLE 4: Teste de Levene para igualdade das variâncias e Teste t para amostras independentes presumindo variâncias equivalentes

	Improvement % G1	*Improvement % G2*
Mean	5,4	9,6
Variance	3,50	8,89
n	14	14
Grouped variance	6,20	
Difference	**4,2 %**	
Mean difference hypothesis	0,05	
gl	26	
Levene's F	0,728	
Levene's *p*	0,401	
Statistic t	-4,50	
***p* (two-tailed)**	**0,0001**	
Critical t (two-tailed)	2,06	

Discussion

In a recent research TOD & IREDALE (2005) investigated the effect of psychological training in the bench press force production. Twelve men and eight women, whit experience in weight training executed five repetitions in a bench press plugged in a modified dynamometer (Biodex) tree times. The peak force after mental training was significant different (p = 0,003) and better than the stimulated and the control groups (p = 0,01). Those result show that mental training can help gains in force production in bench press for this group. This study corroborates with another papers.

In Another research YUE & COLE (1992) compared the maximal voluntary contraction after two muscle training programs, first with maximal isometric and another only mental training. The isometric group got 30% improvement for fifth finger abduction, the mental group got 22% improvement and the control group improved only 3.7%. Those results shows that force gains can come without muscle activation.

HERBERT et al (1998) verified differences between isometric and mental imagery training. The results demonstrated better gains for real training (17,8%), than imaginary training (6,8%) and control group (6,5%). However HERBERT et al. (op. cit.) study does not associate the mental imagery to muscle strength training as in this study.

TENENBAUM et al. (1995) compared the effects of different techniques of mental imagery training on isokinetic leg strength and did not find results demonstrating best gains for imagery training group (24,6%), the control group had more expressive improvement (39,1%).

Conclusion

After all tests we can conclude that strength training associated with mental imagery training can produce better results than the strength training itself after 4 weeks training.

We recommend mental imagery training associated to strength training for better gains in maximal strength.

Another paper studying mental imagery training should be tried with different methodology and other force production.

REFERENCES

SOUSA, A.P.S.de; SCALON, R.M. O Treinamento Mental como uma variável significativa na performance de atletas e na aprendizagem de habilidades motoras.Disponível em: *http://www.efdeportes.com/ Revista Digital* - Buenos Aires - Año 10 - N° 75 - Agosto de 2004.

JEANNEROD, M. The representing brain: neural correlates of motor intention and imagery. *Behav Brain Sci.* 17: 187-245, 1994.

JACKSON, P.L.; LAFLEUR, M.F.; MALOUIN, F.; RICHARDS, C.; DOYON, J. Potential role of mental practice using motor imagery in neurologic rehabilitation. *Arch Phys Med Rehabil,* 2001.

DECETY, J.; GRE`ZES, J. Neural mechanisms subserving the perception of human actions. *Trends Cogn Sci* 3:172-8, 1999.

FELTZ, D.L.; LANDERS, D.M. The effects of mental practice on motor skill learning and performance: a meta-analysis. *J Sport Psychol* 5:25-57, 1983.

DEIBER, M.P.; IBANEZ, V.; HONDA, M.; SADATO, N.; RAMANS, R.; HALLETT, M. Cerebral processes related to visuomotor imagery and generation of finger movements studied with positron emission tomography. *NeuroImage* 7:73-85, 1998.

RUBY, P.; DECETY, J. Effect of subjective perspective taking during simulation of action: a PET investigation of agency. *Nat Neurosci* 4:546-50, 2001.

STEPHAN, K.M.; FINK, G.R.; PASSINGHAM, R.E. et al. Functional anatomy of the mental representation of upper extremity movements in healthy subjects. *J Neurophysiol,* 73:373- 86, 1995.

LAFLEUR, M.F.; JACKSON, P.L.; RICHARDS, C.; MALOUIN, F.; EVANS, A.; DOYON, J. Motor learning produces parallel dynamic functional changes during the execution and imagination of sequential foot movements. *Neuroimage* 16:142-57, 2002.

ELKO, K.;. OSTROW, A.C. The effects of three mental preparation strategies on strength performance of young and older adults.

J. Sport Behav. 15: 34-41, 1992.
GOULD, D.; WEINBERG, R.; JACKSON, A.. Mental preparation strategies, cognitions, and strength performance. *J. Sport Psychol.* 2:329-339, 1980.
SHELTON, T.O.;. MAHONEY, M.J. The content and effect of "psyching-up" strategies in weight lifters. *Cogn. Ther. Res.* 2: 275-284, 1978.
THEODORAKIS, Y.; WEINBERG, R.; NATSIS P.; DOUMA, I.; KAZAKAS, P. The effects of motivational versus instructional selftalk on improving motor performance. *Sport Psychol.* 14:253- 272, 2000
TYNES, L.L.; MCFATTER, R.M. The efficacy of "psyching" strategies on a weight-lifting task. *Cogn. Ther. Res.* 11:327- 336, 1987.
WEINBERG, R.S.; GOULD, D.; JACKSON, A. Relationship between the duration of the psych-up interval and strength performance. *J. Sport Psychol.* 3:166-170, 1981.
WHELAN, J.P.; EPKINS, C.C.; MEYERS, A.W. Arousal interventions for athletic performance: Influence of mental preparation and competitive experience. *Anxiety Res.* 2:293-307, 1990.
WILKES, R.L.; SUMMERS, J.J. Cognitions, mediating variables, and strength performance. ***J.*** *Sport Psychol.* 6:351-359, 1984.
TOD, D.A; IREDALE, K.F.; MCGUIGAN, M. R.; STRANGE, D.E.O.; GILL, N. "PSYCHING-UP" enhances force production during the bench press exercise *Journal of Strength and Conditioning Research* 19(3), 599-603, 2005.
CAUDILL, D.; WEINBERG, R. The effects of varying the length of the psych-up interval on motor performance. *J. Sport Behav.* 6:86-91. 1983.
LEE, C. Psyching up for a muscular endurance task: Effects of image content on performance and mood state. *J. Sport Exerc. Psychol.* 12:66-73, 1990.
WEINBERG, R.; JACKSON, A.; SEABOUNE, T. The effects of specific vs nonspecific mental preparation strategies on strength and endurance performance. *J. Sport Behav.* 8:175- 180, 1985.
BRODY, E.B.; HATFIELD, B.D.; SPALDING, T.W.; FRAZER, M.B.; CAHERTY, F.J. The effects of a psyching strategy on neuromuscular activation and force production in strength-trained men. *Res. Q. Exerc. Sport* 71:162-170, 2000
TENENBAUM, G.; BAR-ELI, M.; HOFFMAN, J.R.; JABLONOVSKI, R.; SADE, S.; SHITRIT, D. The effect of cognitive and somatic psyching-up techniques on isokinetic leg strength performance. *J. Strength Cond. Res.* 9:3-7, 1995.
MURPHY, S.M.; WOOLFOLK, R.L.; BUDNEY, A.J. The effects of emotive imagery on strength performance. *J. Sport Exerc. Psychol.* 10:334-345, 1988.
KRAEMER, W.J.; HAKKINEN, K. *Treinamento de força para o esporte.* Porto Alegre: Artmed, 2004.
YUE, G.; COLE, K.J. Strength increases from the motor program: comparison of training with maximal voluntary and imagined muscle contractions. *J Neurophysiol.* May,67(5):1114-23, 1992.
HERBERT, R.D.; DEAN, C.; GANDEVIA, S.C. Effects of real and imagined training on voluntary muscle activation during maximal isometric contractions. *Acta Physiol Scand.* Aug;163(4):361-8, 1998.

THE MENTAL TRAINING INFLUENCE IN STRENGTH GAINS AFTER FOUR WEEKS OF PRACTICE

Abstract

Mental imagery training consists of mentally repeating an imagined movement many times with the intention to improve motor performance (JEANNEROD, 1994). The purpose of this investigation is to verify if mental training helps to increase muscular strength after four weeks of training. Twenty eight male, young adults, with experience in strength training participated in this study. After 1-RM for bench press, subjects were randomly separated in two groups, strength training (G1) and mental imagery training (G2). They trained for 4 weeks, 3 days a week, 3 sets of 4 to 5 repetitions with 90% of their maximal repetition. The G2 had mental imagery training before the strength training and during the intervals. Results demonstrated better gains for G2 (9,6%) than G1 (5,4%), what indicates that mental imagery training is a good strategy for better gains in strength training programs.

INFLUENCE du ENTRAîNEMENT MENTALE SUR le PROFIT de FORCE APRÈS 4 SEMAINES DE PRACTICE

Résumé

La pratique mentale consiste à répéter un mouvement imaginé diverses fois avec l'intention d'améliorer la performance motrice (JEANNEROD, 1994). L'objectif de l'étude a été vérifier si à travers la formation mentale c'est possible qui se produise une augmentation significative dans la force musculaire maxima dans quatre semaines de formation. Ont participé de l'étude 28 hommes entraînés avec âge entre 18-30 des années. Ont été utilisés des essais de 1RM pour l'exercice de supino. Après l'essai de 1RM les sujets ont été divisés aléatoirement dans deux groupes expérimentaux, groupe de force (GF) et groupe force mentale (GFM). À partir du chargement maximum vérifié, a été prévu un pourcentage de 90% de la 1RM dans laquelle les volontaires des tous les deux les groupes auraient que réalisera trois séries de 4 à 5 RM, dans un total de 12 sessions de formation 3 fois hebdomadaires. L'intervalle entre les séries, a été de 3 minutes. À partir de la 7ème formation ont été ajoutés 5% de chargement du poids d'entraînement de tous les participants. Pour la formation mentale, les personnes de GFM ont été demandées qui réalisaient une simulation mentale du mouvement utilisé. Les résultats ont présenté que la formation mentale produit des profits de force significativement supérieure (9,6% d'amélioration dans moyenne) que la formation de musculação appliquée isolément (5,4% d'amélioration dans moyenne). Il se conclut que le groupe qui a réalisé la formation mentale allié à l'entraînement de force a développé plus grandes augmentations de la force concernant le groupe qui a réalisé seulement la formation de force.

LA INFLUENCIA DEL ENTRENAMIENTO MENTAL EN AUMENTOS DE FUERZA DESPUÉS DE CUATRO SEMANAS DE PRÁTICA

Resumen

El entrenamiento mental consiste en repetir mentalmente un movimiento imaginado muchas veces con la intención de mejorar el funcionamiento motor (JEANNEROD, 1994). El propósito de esta investigación es verificar si el entrenamiento mental ayuda a aumentar la fuerza muscular después de cuatro semanas de entrenamiento. Veinte y ocho hombres, adultos jóvenes, con experiencia en el entrenamiento de fuerza participaron de este estudio. Después del 1-RM para la prensa de banco, los sujetos fueron separados de manera aleatoria en dos grupos, entrenamiento de fuerza (G1) y entrenamiento mental (G2). Entrenaron por 4 semanas, 3 días a la semana, 3 series de 4 a 5 repeticiones con 90% de la repetición máxima. El G2 tuvo entrenamiento mental antes del entrenamiento de la fuerza y durante los intervalos. Los resultados demostraron mejores aumentos para G2 (9.6%) que G1 (5.4%), qué indica que el entrenamiento mental es una buena estrategia para mejores aumentos en programas de entrenamiento de la fuerza.

INFLUÊNCIA DO TREINAMENTO MENTAL SOBRE O GANHO DE FORÇA APÓS 4 SEMANAS DE TREINAMENTO

Resumo

A prática mental consiste repetir um movimento imaginado diversas vezes com a intenção de melhorar o desempenho motor (JEANNEROD, 1994). O objetivo do estudo foi verificar se através do treinamento mental é possível que ocorra um aumento significativo na força muscular máxima em quatro semanas de treinamento. Participaram do estudo 28 homens treinados com idade entre 18-30 anos. Foram utilizados testes de 1RM para o exercício de supino. Após o teste de 1RM os sujeitos foram divididos aleatoriamente em dois grupos experimentais, grupo de força (GF) e grupo força mental (GFM). A partir da carga máxima verificada, foi predito um percentual de 90% do 1RM em que os voluntários de ambos os grupos teriam que realizar três séries de 4 a 5 RM, num total de 12 sessões de treinamento 3 vezes semanais. O intervalo entre as séries, foi de 3 minutos. A partir do 7º treinamento foram acrescentados 5% de carga do peso de treino de todos os participantes. Para o treinamento mental, os indivíduos do GFM foram solicitados que realizassem uma simulação mental do movimento utilizado. Os resultados apresentaram que o treinamento mental produz ganhos de força significativamente superiores (9,6% de melhora em média) que o treinamento de musculação aplicado isoladamente (5,4% de melhora em média). Conclui-se que o grupo que realizou o treinamento mental aliado ao treino de força desenvolveu maiores aumentos da força em relação ao grupo que realizou somente o treinamento de força.