CLINICAL TRIAL IN PSYCHOLOGY OF SPORT

Examining physical training versus physical and mental training programmes in Swimrun semi-professional athletes: A randomised, controlled, trial

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Abstract

Objective: The purpose of this study was to identify the effect of two psychological interventions, named 'Mental imagery' and 'Motivational self-talk' training used in combination, on perceived excertion and flow state in a sample of Swimrun semi-professional athletes.

Methods: Thirty male semi-professional athletes, enrolled for a Swimrun competition, were randomly selected into an experimental group (EXP) and a control group (CON). The modified Borg Scale of Perceived Exertion (RPE) and the Flow State Scale (FSS) were the dependent variables. Before a Swimrun competition, the EXP Group performed both physical and mental training programs, while the CON group only performed a physical training program. Immediately after the race, we measured the dependent variables in both groups.

Results: The results of unpaired-t test showed that levels of perceived exertion were less in EXP group than CON group, ($t(28) = 12.87$, $P < .001$), while levels of flow state were higher in EXP group than CON group ($t(28) = 5.96$, $P < .001$), immediately after the end of the endurance competition. The use of both mental imagery and self-talk training in order to reduce perceived exertion and improve flow state was supported ($P < .001$).

Discussion and Conclusion: The findings of this study support the psychobiological model of endurance performance. Our research is the first to demonstrate that mental imagery used in combination with motivational self-talk can reduce the perceived exertion and improve the flow state in Swimrun athletes during their endurance performance.

KEY WORDS: psychology, sports; physical exertion; psychotherapy; physical endurance; athletes.

Riassunto

Introduzione: L'obiettivo di questa ricerca è stato quello di studiare l'effetto di due tecniche psicologiche usate in combinazione, la "Mental Imagery" e la "Motivational Self-Talk", sulla percezione dello sforzo e sul "Flow state" di un campione di atleti sportivi semiprofessionisti di "Swimrun".
Metodi: Un gruppo di trenta atleti semiprofessionisti iscritti ad una gara di Swimrun è stato randomizzato in un gruppo sperimentale (EXP) ed in un gruppo di controllo (CON). Sono state utilizzate come variabili dipendenti una versione modificata del questionario di Borg per la misura dello sforzo percepito ("Borg Scale of Perceived Exertion") ed una versione modificata del questionario per la misura del Flow State ("Flow State Scale"). Prima della gara il gruppo EXP ha effettuato un programma di allenamento fisico e di training mentale con le due tecniche psicologiche "Mental Imagery" e "Motivational Self-Talk", mentre il gruppo di controllo ha effettuato soltanto il programma di allenamento fisico. Immediatamente dopo la gara di endurance, sono state misurate le variabili dipendenti in entrambi i gruppi.
Risultati: I risultati del t-test di Student per dati non appaiati ha evidenziato che, immediatamente dopo la gara, i livelli di sforzo percepito erano minori nel gruppo EXP rispetto al gruppo CON ($t(28) = 12.87$, $P < .001$), mentre i livelli di "Flow State" erano maggiori nel gruppo EXP rispetto al gruppo CON ($t(28) = 5.96$, $P < .001$). E' stato confermato che l'uso combinato delle tecniche di "Mental Imagery" e di " Motivational Self-Talk" è efficace nel ridurre lo sforzo percepito e nell'aumentare il Flow State degli atleti di Swimrun ($P < .001$).
Discussione e Conclusione: I risultati supportano la validità del modello psicobiologico nelle gare di endurance. Il nostro studio è il primo a dimostrare l'efficacia della "Mental Imagery" e della "Motivational Self-talk" usate in combinazione sulla riduzione dello sforzo percepito e sull'aumento dei livelli di "Flow State" negli atleti di Swimrun impegnati in gare di endurance.

TAKE-HOME MESSAGE

Motivational self-talk used in combination with mental imagery can reduce perceived exertion and, simultaneously, increase flow state levels in semi-professional Swimrun athletes.

Competing interests - none declared.

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INTRODUCTION

Sport psychology is a proficiency that uses psychological knowledge and skills to address optimal performance and well-being of athletes. Some of the principal strategies include cognitive and behavioral skills training for performance enhancement, counseling and clinical interventions and consultation and training [1–3].

Recently, Mc Cormick et al. systematically reviewed all psychological determinants of whole-body endurance performance [4]. Consistent with the psychobiological model of endurance performance, interventions that influences perception of effort consistently affected endurance performance. The psychobiological model is an effort-based decision-making model [5–9] based on motivational intensity theory [10] and postulates that the conscious regulation of pace is determined primarily by five different cognitive/motivational factors: 1) perception of effort; 2) potential motivation; 3) knowledge of the distance/time to cover; 4) knowledge of the distance/time remaining; 5) previous experience/memory of perception of effort during exercise of varying intensity and duration [11]. Perception of effort could be defined as 'the conscious sensation of how hard, heavy and strenuous a physical task is' [9], and it is the key determinant of this model [11]. According to this model, the conscious regulation of pace is primarily determined by the effort perceived by the athlete [11]. According to the psychobiological model, the ultimate determinant of endurance performance in highly motivated subjects is perception of effort which can be defined as the conscious sensation of how hard, heavy and strenuous exercise is [6–9, 12]. According to the Mc Cormick's review, among different, practical, psychological interventions identified, consistent support was found for using imagery, self-talk and goal-setting to improve endurance performance, even though it is unclear whether learning multiple psychological skills is more beneficial than learning one psychological skill [4]. A recent study was the first able to experimentally demonstrate that 'motivational self-talk' reduces perception of effort, and provides empirical support for previous suggestions that self-talk enhances endurance performance increasing time to exhaustion during high-intensity cycling exercise [13]. According to Mc Cormick's review, psychological skills training could benefit and endurance athlete in many sports such as running, rowing, skiing, canoeing, kayaking, swimming, speed skating, triathlon and race walking [4]. As to our best knowledge, there are no experimental studies about the effects of psychological interventions in Swimrun which is a very tough endurance competition. A Swimrun is a multiple-stage competition involving where participants are running and swimming over a cross-country race-course that involves many transitions between the swim- and run stages of the race. In 2015, the world's first Ultraswimrun, the Stockholm Archipelago Ultra Challenge (SAUC) took place, and it is now considered the toughest available Swimrun race in the world, stretching over some 250 km. The international focus has been growing in the last years, and in 2016 there were more than 180 known races in the world, in 19 countries and on 4 continents [14]. The aim of this randomized, clinical, trial was to study the effects of both motivational self-talk and mental imagery used in combination in order to reduce perceived exertion and improve flow state of the Swimrun athletes during an endurance competition performance.

METHODS

Participants

Twenty-two healthy male (32 ± 4.3 years, 1.74 ± 0.06 m and 72.5 ± 8.4 Kg) trained (2 to 6 years) Swimrun semi-professional athletes were recruited directly by the researchers of the Italian Society of Integrative Psychotherapy for Social Development (SIPISS) Research Center among the competitors of an Italian Swimrun competition. All

partecipants had at least one year experience in resistance training and were non-smokers, non diabetic, and free of cardiovascular, lung, liver disease, and any other diseases. To be eligible to participate in the study, partecipants were required to meet the following criteria: 1) none of the partecipants had performed mental training with the aim of improving sport performance; 2) no consumption of any supplements or drugs; 3) non recent major injury history for the lower and upper-body; 4) no history of psychiatric disorders; 5) no severe cognitive impairment; 6) subjected to a test on mental imagery [Sport Imagery Ability Measure (SIAM)] [15], having a moderate mental imagery ability. The partecipants were randomly assigned to two groups, an experimental, physical and mental training group (EXP; n = 11) and a control, physical training group (CON; n = 11). Mental training was administered via a mental training package (MTP; subsequently described). The study was conducted according to the Declaration of Helsinki. Written and verbal informed consent was obtained from each participant following verbal description all experimental details, with this obtained priority to any experimental data collection.

Study Procedure

Sixteen training sessions occurred over 8 consecutive weeks, with a maximum of two training sessions per week, and a minimum of one day rest between training sessions.

Training program

Physical training protocol

Partecipants of both experimental and control groups completed sixteen 60-min laboratory-based treadmill exercise sessions (two sessions were completed each week). Partecipants started at a heart rate of 40% to 50% of maximal heart rate reserve determined by use of the Karvonen formula [16]. The intensity of the exercise was increased by 5 minutes to reach 15 minutes at 70% to 80% of heart rate reserve. Moreover, participants performed resistance (muscle strengthening) exercises of the lower body followed by stretching of the upper and lower body. Resistance exercises included 2 sets of 10 repetitions on each leg on 3 resistance machines: the leg press, leg extension, and leg curl. Weight was increased as tolerated. Stretching exercises comprised 1 set of 10 repetitions each of trunk rotation, hip abduction, and stretches of hamstrings, quadriceps, calves, and ankles performed on padded tables under supervision of an exercise physiologist.

Mental training protocol

The partecipants received two ~ 60 min training sessions a week for two months before the competition, delivered by the same certified sport psychologist for all partecipants. The MTP required the combination of motivational self-talk (*M*-ST) and mental imagery (MI). It is well known that mental skills such as self-talk and mental imagery are highly related to successful accomplishment of tasks [17] and a combination of MI and *M*-ST induce better information-processing models in the performance domain, than their singular discrete implementation [18, 19].

Mental Imagery training

Imagery is also called "visualization" or "mental rehearsal". In sports, the subject of imagery is traditionally related to movement, so called 'motor imagery' [20]. The main aim of motor imagery is to enhance specific motor actions [21]. Motor imagery is a cognitive strategy used by athletes for learning and optimizing their specific movement tasks [22]. In sport imagery research there are five types of imagery; these are cognitive specific (CS; imagery of skills), cognitive general (CG; imagery of strategies, routines, and game plans), motivational specific (MS; imagery of goal achievement), motivational general-arousal (MG-A; imagery of stress, anxiety, and arousal), and motivational general-mastery (MG-*M*; imagery of being self-confident, mentally tough, focused, and positive) [23]. In our study we used a guided mental imagery combining a picture of the final goal—winning the Swimrun tournament— with one of the process by which that goal is achieved—mental-

ly practicing the race needed to perfect the Swimrun race. In the present study, we applied the following types of mental imagery interventions: MS, MG-A and MG-*M*. The flow mental imagery recording was based upon the nine major tenets of flow [24] and it was twenty minutes in length.

Motivational Self-Talk training

Self-talk refers to verbalization or a statement addressed to the self before, during and after the imagined and actual trials actions. The partecipants of the experimental group were asked to identify and write negative self-talk statements that occurred before, during and after the training sessions and to change them into positive and motivational statements [19]. Indeed, motivational self-talk is composed of positive phrases that encourage you to keep on track and work through challenges. For example: 'I can swim intensively', 'I can run strenuously'.

Control group

Control partecipants engaged in physical training, instead experimental partecipants engaged in physical and mental training programs.

Setting

The setting of the physical and mental training programmes was the SIPISS Psychological Research Center, at Milan (Italy). The Borg's scale was administered immediately after the end of an Italian Swimrun competition named the 'Swimrun cheers'. This endurance race occurred on August 2016, 27th in Maggiore Lake (Piedmont, Italy). It was a multiple-stage competition in which participants ran and swam without transition zone for 39 kilometers (Km);12 Km by swimming and 27 Km by running.

Outcome measures

The perceived exertion

The study of effort perception has long been dominated by the work of Gunnar Borg. During the 1960's Borg introduced the concept of 'perceived exertion' as a subjective perception of the effort during physical work, and developed a scale to measure this concept, known as the Rating of Perceived Exertion (RPE) scale. Borg's RPE scale was widely endorsed and used for monitoring training load in order to avoid overreaching and overtraining phenomena [25, 26]. The guidelines of the American Heart Association (AHA), for example, recommend monitoring cardiovascular responses to resistance exercise, including the heart rate (HR), blood pressure (bp), and perceived exertion, and using the RPE scale to set the intensity of strength training in both young and older adults [27].

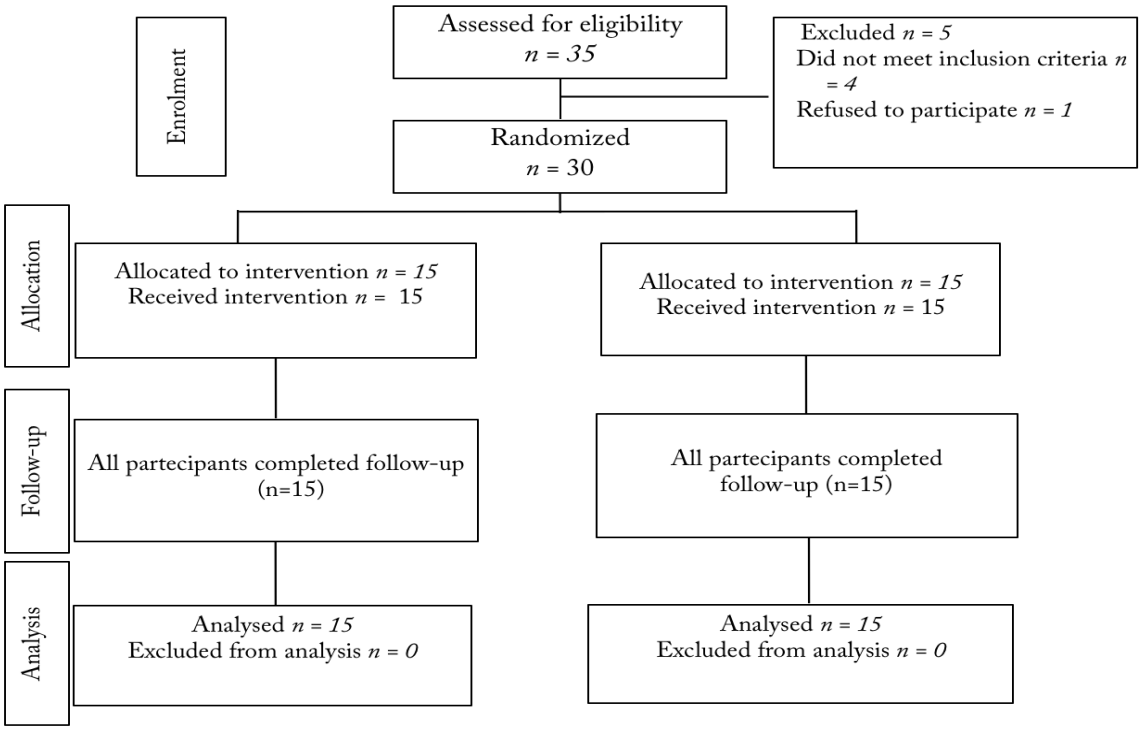
The Borg's RPE Scale is a method for measuring 'overall' perceived exertion, effort and fatigue in physical work. Ratings of Perceived Exertion or RPE is determined in training of athletes and recreational sports, and in epidemiological evaluations of exercise intensity and daily physical activities. Currently, there are three versions of scale: the original scale (RPE scale) that rated exertion on a scale of 6-20, the Category Ratio version (Borg CR-10 Scale) with the ratings between 0 to 10 [28–31], and the Borg CR-100 Scale (also called 'centiMax scale'), the third and more fine-graded one that was introduced by Elisabeth Borg [31–33, 34]. In the present study we used the Borg CR100 scale. This scale varies from 0 to 100 (see Fig. 1) with the verbal descriptors placed where they belong on a ratio scale, i.e., so as to give ratio data comparable to what is obtained with traditional psychophysical methods such as magnitude estimation [35, 36]. Thus, 0 is described as 'nothing at all' (i.e., no subjective or perceived force), and 100 is described as "maximum" (i.e., maximal subjective or perceived force) and anchored in a previous experience of a maximal perceived exertion. In between these points, there are other descriptors such as "minimal", extremely weak, very weak, weak, moderate, somewhat strong, strong, very "strong", and extremely strong [33, 37, 38].

The flow theory

In the sporting context, the athletes will experience flow when goals are clearly set by the

athlete, feedback is immediate and unambiguous [39]. The Flow Scales are used to assess flow, and they have been developed and validated by Jackson and Marsh [40]. Extent of flow experienced in a particular event or activity (e.g., a race, a work project, or a test) is measured by the State Flow Scales. The flow state, a positive experiential state, occurs when the performer is totally connected to the performance, in a situation where personal skills equal required challenges. It is a state aspired to by elite athletes, but also one that can be enjoyed by any level of sport participant [41- 43]. The Flow State Scale was used in the present study. It is a 36 item self-report scale that measures the intensity with which an athlete experiences flow. The nine FSS scales of this 36-item instrument represent the dimensions of flow discussed by Csikszentmihalyi [24] and each scale is measured by four items. Jackson and Marsh (1996) reported the development of a Flow State Scale (FSS) for use in sport and physical activity. Jackson and Marsh reported high internal consistency estimates for the subscales and evidence for nine first-order factors and one second-order factor when confirmatory factor analytic techniques were used [40]. The FSS includes 36 items with a five-point Likert scale (ranging from 1 – total disagreement to 5 – total agreement). This 36-item instrument has nine subscales of four items each, labelled challenge-skill balance (e.g., 'I was challenged, but I believed my skills would allow me to meet the challenge'), action-awareness merging (e.g., 'I made the correct movements without thinking about trying to do so'), clear goals (e.g., 'I knew clearly what I wanted to do'), unambiguous feedback (e.g., 'It was really clear to me that I was doing well'), concentration on task at hand (e.g., 'My attention was focused entirely on what I was doing'), sense of control (e.g., 'I felt in total control of what I was doing'), loss of self-consciousness (e.g., 'I was not concerned with what others may have been thinking of me'), transformation of time (e.g., 'It felt like time stopped while I was performing'), and autotelic experience (e.g., 'I found the experience extremely rewarding'). Scores of each subscale are added to obtain a total Flow score. The total score of each subscale ranges from 4 to 20, while the overall score ranges from 36 to 180. The Italian version of the Flow State Scale was te-

Figure 1. CONSORT flow diagram of the study. The final number of participants analysed is based on the principle of complete case analysis and intention-to-treat principle.



sted by Diana et al. [44] on a sample of 136 Italian athletes. The results showed good reliability of the overall instrument (α = 0.88) and of its subscales (minimum α = 0.75), with the exception of the 'SB' scale. Moreover, the Italian version of the Flow State Scale was recently tested by Morganti et al. [45].

Statistical analysis

We used Statistical Package for the Social Sciences (SPSS)-version 16.0 to perform statistical analyses. An independent T-test was used to determine whether there was a statistically significant difference in perceived exertion and flow state scores between the two independent groups (i.e., the 'Experimental group' and 'Control group'). All statistical tests were considered significant as p value lower than 0.05.

RESULTS

In order to assess success of matching exercise intensity, across groups, mean Flow State and Rating Perceived Exertion were compared. At post-intervention testing, there were statistically significant differences in flow scores as measured by the Flow State Scale between the control group (M = 126.13, SD = 6.78) and the experimental group (M = 145.73, SD = 10.77), (t(28) = 5.96, P < .001) (see Table 1). Furthermore, RPE scores were different between the experimental group (M = 70.80, SD = 2.57) and the control group at post-test (M = 86.20, SD = 3.86) (t(28) = 12.87, P <.001) (see Table 2). Therefore, there was a statistically significant difference between the groups for mean RPE and mean FSS scores.

DISCUSSION AND CONCLUSION

The aim of this study was to assess the effects of mental imagery and motivational self-talk used in combination on perceived exertion and flow experience of Swimrun semi-professional athletes during a real competition. Similar to other researches [46, 47], the present study sought to examine the effects of mental imagery and motivational self-talk on flow intensity as measured by the Flow State Scale and on perceived exertion as measured by CR 100 Borg's scale. The present study expanded upon past research. Indeed, this is the first study to directly compare physical versus physical and mental training using imagery in combination with self-talk in Swimrun that is a relatively new sport endurance. The findings of our study showed that mental training can affect positively both the perception of effort and flow experience of the athletes during their endurance competition. However, our study has some limitations which we have to point out. In our research, the control group did not receive a placebo. The placebo effect refers to a favourable outcome that arises purely from individuals' belief that they have received a beneficial treatment. Increased expectations of performance improvement might account for the effects of some psychological interventions [4]. Indeed, Mc Cormick et al. encouraged sport psychologists to compare psychological interventions with alternative control treatments or inert solutions, pills or capsules that are described as beneficial for endurance performance. Moreover, our study did not consider any physiological determinants as outcome measures of endurance performance [4]. There are various methods of measuring endurance performance in laboratory and field settings. The most commonly used protocols are time-to-exhaustion tests and time trials. Additional measures include constant-duration tests and incremental tests [48]. Numerous researchers argue that VO2 max, the lactate threshold, and economy/efficiency are the most important physiological determinants of endurance performance [49, 50]. Nevertheless, we can expect that a more flow experience and a less perceived exertion at the end of a real endurance competition, correspond to a higher level of endurance performance occurred, consistently with some studies which have found the positive effect of motivational Self-Talk (ST) and mental imagery on endurance performance [13, 51]. Therefore, our study is consistent with other studies which predicted that any physiological or psychological factors affecting perception of effort will affect endurance performance [7, 8]. Indeed, according to Tenenbaum et al., the use of a mental strategy can affect distinct

determinants of effort sensation such as the physical, motivational and affective ones [52]. Moreover, interventions such as sleep deprivation [53], naloxone administration, [54] and mental fatigue [8] have been shown to elevate rating of perceived exertion (RPE) and hinder endurance performance, whereas interventions such as physical training [55], nutritional intake [56] and psycho-stimulant manipulations [57] have been shown to reduce RPE and enhance endurance performance. Given its components, sport is a prime situation to study flow which has been shown to have great value to athletes trying to reach full potential. Self-talk and flow have both been researched and found to have valuable links to higher level athletic performances. Some studies have investigated the relationship between types of self-talk and flow in competition. A significant correlation between motivational self-talk and flow was found in track athletes competing in middle and long distance events during an indoor track meet [58]. The functions of self-talk and flow overlap in a number of ways. Two of the functions of self-talk are to reduce anxiety and build confidence [59]. Motivational self-talk is used to provide self-efficacy, and self-efficacy is a key component to the flow experience [58]. In conclusion, consistently with the Marcora's 'Psychobiological model', our study has highlighted that the use of motivational self-talk in combination with mental imagery, may be useful to improve performance in endurance sports, because the perceived exertion is the main factor limiting both the human performance and endurance activities.

Table 1. Difference between EXP and CON groups for flow state scores.

Group Statistics

Type of Treatment		**N**	**Mean**	**Std. Deviation**	**Std Error Mean**
Flow State Scale	EXP Group CON Group	15 15	145.73 126.13	10.77 6.78	2.78 1.75

Independent Samples Test

		Levene's Test for Equality of Variances		**t-test for Equality of Means**					**95% Confidence Interval of the Difference**	
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
Flow State Scale	Equal variances assumed	2.21	,148	5.96	28.00	,000	19.60	3.29	12.87	26.33
	Equal variances not assumed			5.96	23.59	,000	19.60	3.29	12.81	26.39

Table 2. Difference between EXP and CON groups for perceived exertion scores.

Group Statistics

Type of Treatment		**N**	**Mean**	**Std. Deviation**	**Std Error Mean**
Borg 100 Cr Scale	EXP Group CON Group	15 15	86.20 70.80	3.86 2.57	1.00 ,66

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Borg 100 Cr Scale	Equal variances assumed	3.04	,092	12.87	28.00	,000	15.40	1.20	12.95	17.85
	Equal variances not assumed			12.87	24.38	,000	15.40	1.20	12.93	17.87

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