

Article

# Interference effect review: the grand paradox

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## Abstract:

It has yet been established what is the superior form of training. What is important to understand is that our selections of exercise are goal dependent. In our industry there is three outcomes we can chase, performance, aesthetics, or longevity. What is recommended to one individual can be avowed against another person. However, if there is one thing that the science has shown is the benefits of two methods of training -- Resistance and Aerobic training. Also termed, Concurrent Training (CT). The American College of Sports Medicine recommends the implementation of both these modalities. It is the combination of these to training styles that gave birth to the term *Concurrent Training*. Concurrent Training is a not new field of study in the exercise physiology world. Since the start both modalities of training were being studied. However, it was in 1980 where the first true CT study was conducted. For the past 40 years there has been an axiomatic ideology that Aerobic training regresses strength adaptations, arising the question of whether Olympic lifters and power lifters should train their cardiovascular system. This article will dive deep what Concurrent Training is and what the literature states.

**Keywords:** Concurrent, Training, Interference Effect

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## 1. Introduction

Concurrent Training is the combination of endurance and resistance training into one periodized program. There is a lot of research still needed to be done on what comes first, should aerobic training precede endurance training or succeed it? Should the athlete train strength one day and the other day train aerobically? Should these two modalities be trained on the same day? Most of the research is indicating that it is goal dependent, and we should train our body to do what most closely relates to our goal first. For example, if the goal is to run a marathon then running should be paramount in training. What we do know about concurrent training is that it is the alternations of peaks in our training. What most of the research is leaning on is the occurrence of overtraining. It is impossible to be the strongest and most aerobically fit we can be all in the same periodized plan. The training must peak in one way. This same undulation in peaks ultimately sacrifices optimal performance in both modalities of training.

## 2. Methods

A comprehensive search of the scientific literature was conducted. Using university-based search engines, PubMed, google scholar, and the National Library of Medicine. The keywords used; Concurrent, Training, Interference effect, Strength, Endurance, Adaptations, Overtraining, Molecular signaling, mTOR, AMPK, Robert Hickson. These terms were mixed and matched to come to a concluding 300 articles which were reviewed. Ultimately, the ones used were ones that fit the desired outcome of this article. Explaining Concurrent Training in a molecular level and a practical way.

## 3. Why Concurrent Training?

At the start of our exercise history there has been biases. Resistance Training is superior to Endurance Training, and vice versa. There has been multiple of studies done on endurance training and the same can be said about resistance training. According to the Bamman, resistance training allowed older population to revert their muscle mass and strength to younger levels [1,4]. The scientific literature has proved that strength training can add multiple benefits including our bone mineral density health, increased performance, and a reduction in injury [5]. The literature also has found the mass benefits in cardiovascular training. Reducing risk of cardiovascular diseases, improving maximal oxygen uptake (VO<sub>2</sub>max), increased lactate threshold, and many

other findings [1,2,5]. That being said, there is some cons of just training in one modality and neglecting the other. For example, if we were to train only aerobically for the rest of our lives we would face the problem of developing overuse injuries [8]. Neglecting resistance training would inhibit our strength and power adaptations. According to Keller and colleagues strength decreases by 1% and power by 1.5 % as we age [4]. Failure to build a good strength baseline would only make for a bigger problem down the line. Ultimately, we see a recurring theme of balance lifestyles in all facets of life. In exercise, we have to balance these facets of training. Concurrent Training is important because we must balance and reap the benefits of both. Failure to engage in both cardiovascular and resistance training sacrifices longevity.

#### 4.1 Concept of Interference Effect

In 1980, a study consisting of three groups was conducted. The strength (S), endurance (E), and concurrent group (S+E). The strength group came had a 10-week strength program to follow, the endurance group had a 10-week cycling program to follow, and the concurrent group did both. After the 10 weeks Hickson's practical application concluded that endurance athletes do not need to strength train, but it would do no harm to them [3]. Strength athletes should not endurance train as it would hinder their performance. In the graph below, you will see the week to week increase in 1RM from both S and S+E group. The positive slope shows the gradual increase in both groups. It is in week 7 where we can see a negative slope for the concurrent group. A hypothesis for this would be overtraining. Overtraining is when the human body is under too much stress and no adequate time is given to recover [8,9]. This conclusion in the 1980s would follow a whole series of research and gave birth to the term the interference effect.

#### 4.2 Phenomena of the Interference Effect

The interference effect states that endurance training signaling stunts muscle growth [6]. This inhibition in muscle growth leads to a decrease in muscle size and force capacity. There is a positive correlation in size and force output of muscle [1]. The scientific phenomena occurring when we resistance train is an upregulation of the mammalian target of rapamycin (mTOR), this activates ribosomes which synthesize protein. Which promotes muscle growth, a classic strength training adaptation [1,2,4]. In endurance training we are still taxing our body but in more of an energetic and metabolic way [5]. Training aerobically sends a signal to our cells called 5' adenosine monophosphate-activated protein kinase (AMPK) [6,7]. This molecule is essential during endurance training because it regulates energy metabolism, this prevents Adenosine Triphosphate (ATP) from becoming depleted. This goes on to signal mitochondria gene transcription which our muscle cells will develop more mitochondria. This adaptation is what we know as mitochondria biogenesis a classic adaptation of endurance training [7]. This is the big picture of the molecular signaling that occurs when we undergo a certain modality of training. There are scientific studies which state the signaling of AMPK blocks the mTOR signal [6]. This is where the interference effect term was born. If we engage in endurance training, we are interfering our strength adaptations. It is also worth to mention that Strength training does not interfere with AMPK signaling [6]. Hickson's study found that endurance groups still increased their VO<sub>2</sub> max with strength training [3]. The strength group however saw a decrease in strength after the 7th week. This has led to a whole line of research which is determined to find the best way to optimize concurrent training.

### 5. Summary and Practical Applications

Training is very situational and goal dependent. It would be very foolish to say one way is the best approach, however, the studies being published are shining light on what approach would be ideal for our goal. Athletic performance is very dependent on the smallest edge especially at the elite level. A split of a second can define careers and outcomes of events. More scientific research is needed to truly define the best approach for a specific sport. What we do know is the effects of AMPK when activated by endurance training, an anaerobic athlete should tread carefully when engaging in aerobic activities. As a fitness professional, you should caution to implement concurrent training depending on your client. If the athlete is aerobic or anaerobic plan accordingly. If they are general population they will benefit from both modalities but be weary of your programming, as overtraining is the only obstacle.

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