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# A Coaches Guide- How to Read a Research Paper

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Coaches (and the public) are bombarded by media with the latest studies; advertisements boast of studies "proving" that a product works. In some cases, the information is presented with the best of intentions as the media wants the public to know about studies that are relevant to living a healthier life. In other cases, however, product ads are intentionally deceiving. As a coach, you will be asked questions about products or supplements or the meaning of some study reported in the media. As a coach, you can assist your athletes in becoming discerning consumers. This article is designed to assist you in becoming a smarter consumer.

**"Prove"**

Science does not really "prove" anything; what science seeks is to find the truth through objective study and experimentation. An aim of science is to build a body of evidence so that a consensus can hopefully be reached among scientists in a field. Studies reporting, or advertisements stating, that it is "proven" that a product works should be considered suspect. Often it is the marketing department that interjects this term into the advertisement.

**Find the study**

In some cases finding the study can be the biggest challenge. Product advertisements often say something like "university studies show" or "university studies prove". In some cases, these studies are never published in peer reviewed journals. They sometimes are presented as papers or posters at conferences; however, this level of presentation does not reach the same high standard of peer review as is necessary for publication of a complete report in a scientific journal. Some papers are published in foreign language journals (Russian and Chinese journals are particularly common sources for dietary supplement studies) which increases the difficultly in finding them much less being able to read them. A good source to find at least an abstract of the study is PubMed (**http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed**); you can search the database of journals in the areas of health, sport science and medicine. In some cases the full study may not be available to you without a charge. In some cases the abstract that is available for free online can provide with enough information to be discerning about the quality and application of the study.

**Compare it to the body of evidence.**

A single study should never be used to overturn a large body of evidence unless there is some very good reason. For instance, a study showing that a product does provide a benefit should be considered in light of the hundreds of papers that may have been published that show no benefit.

**Who funded the study?**

Some studies are paid for by the manufacturer or a similarly interested party. Such funding does not automatically invalidate the findings of the study, but it should raise a red flag especially if it is the only paper showing a positive result.

**Subjects**

The methods section of a paper or abstract will tell you a lot of information especially about the subjects. A tenet of science, especially in the health and sport science fields, is to be very cautious in applying the results of a study from one population to a different population. For instance, the results of a study on sedentary, post-menopausal women may not apply to a healthy 25 year old male who trains 15 hours per week. In a pure sense, studies on men should probably not be applied to women or vice ver-

sus. A common dietary supplement industry scheme is to take a study on a population like cardiac rehab patients that took some supplement and try to apply it to an athletic population.

Other questions to consider about the subjects:

- Are they training as much as my athletes?
- Are they the same caliber as my athletes?
  - For instance, if you are coaching athletes capable of scoring points in a World Cup race, does a study on recreational cyclists have much to offer?
  - The converse is also true: If the study were done on elite athletes, can you apply the findings to a beginning junior?
- What sort of training did the subjects do prior to the study?

**What was the length of the study?**

Look in the methods section to see how long the subjects were involved in the study. In some cases, the length of the study may not matter; however, if you are looking for training effects in a study then a very short study may not have given the training plan enough time to show an effect. The reverse can also be true where a big gain can be seen in a short period of time.

**Methodology**

A good study will have a control group and an experimental group(s). The control group partakes in the study but does not receive whatever treatment is being studied. For example, in a dietary supplement study, the control group would not receive the supplement being studied. In most cases, the subjects in the control group will receive a placebo, usually sugar or something that looks like the product but does not contain an element that should change anything. For instance, in a study on iron supplementation, the control group might receive a sugar pill containing no iron.

Ideally, none of the participants knows if the subject is in the experimental or control group and none of the researchers interacting know who is in which group either. If the subjects do not know who is in the C or the E group, then it is a single blind study; if no one directly involved in the study knows, then it is a double blind study. In the latter case, the information on who is in which group is revealed after the study is concluded. For instance, in a double blind study run by Dr. Jekyll to study the use of a new dietary supplement, Mr. Hyde might mix the powder and put it into bags for the each participant. Mr. Hyde would be the only person with access to who had the supplement and who had the placebo until after the study was completed. In some cases, it is difficult or impossible to have a single or double blind study. For instance, in a training study looking at interval training, the athletes are going to know if they are performing interval training or not.

Subjects should be randomly assigned to the experimental groups or control group. Random assignment can be done so that everyone has an equal chance to be in each group. In some cases, the researcher may use other methods to assign people to groups so that the groups are equivalent.

In theory, the control group should not improve since they have undergone no intervention. In some exercise studies, the control group is a sedentary population. In some exercise studies, the control group does everything the E group does except for one thing (the intervention).

Another aspect of the subjects is the number of subjects in the study. One legitimate knock against exercise science studies is that the sample sizes are generally very small which presents issues related to the power of the study. A study with a small sample size means that a few people who improve a lot can skew the results of the study as the studies look at averages between the C and E groups. For this reason, if nothing else, a single study from the exercise science field needs to be taken in context of the body of evidence.

Studies without control groups are problematic in that one cannot ascertain with as much certainty that the improvement was due to the intervention. There are methods to adjust for the lack of a control group. In some cases it is very hard to have a control group. For instance, if you are looking at the top ten kilometer time trial riders in the world, there is no comparable group that could serve as a control group. When dealing with elite athletes, having a control group is very difficult. From an ethical standpoint, in some cases it would be difficult to tell one group of athletes that they do not get a treatment that might be beneficial to them.

Another aspect of dealing with athletes, especially elite athletes, is that scientists studying them might be asking them to alter their training for the sake of a study. In some cases some alteration in training might not affect the athlete, but when dealing with a person's livelihood it is very difficult to have them alter training if such an alteration could be detrimental to their performance.

**Assessing the effect of the intervention**

An intervention is the experimental aspect of the study. Typically in a study, the subjects are tested at the start of the study before any intervention is administered; this pre-test establishes a baseline. The groups are then re-tested using the same protocol at the end of the study. In some cases, the subjects may be tested during the study. Good studies include a period of familiarization trials so that the subjects become accustomed to the equipment used or the protocol or some unique technique. In some studies, an exercise might be used that is not natural in order to look at some aspect of training for instance, pedaling backwards.

The choice of the protocol can be critical to finding an effect of the intervention. Also, the choice of the protocol could lead to results that have little real world application. For instance, many exercise science studies use time to exhaustion as the standard.

At the start of the study, cyclists might be asked to ride for as long as they can at a given intensity like 70% $VO_2$max. Following the intervention, the subjects are re-tested at the same 70% $VO_2$max. The subjects with the intervention might ride longer at that intensity.

One knock against the time to exhaustion method is that it is not a real world situation. There is no event in which the goal is to ride or run as long as possible while maintaining a given intensity. That might be a strategy to be successful, but usually the goal in athletics is to cover a given distance in the shortest amount of time.

**Statistics**

An area of confusion for lay readers of scientific papers is the area involving the statistical analysis. Often the researchers will report a P value. A simple way to think of the P value is to think about the odds of such an event occurring if it were a random happening. A P value of less than 0.05 ($p<0.05$) would mean that there is less than a 5% chance (1 in 20) of the result occurring by chance. (P values depend on sample size and measurement error as well as the strength or potency of an effect.)

In the real world of coaching, one has to look beyond the issue of chance and look at the actual effect. For instance, if an intervention can increase performance by 1%, it might be statistically unimportant. However, in real life a 1% increase could mean victory. A casual analysis of results from recent Olympic Games in timed events shows that the difference between winning a gold medal and finishing in fourth place (and no medal) is 1% or less. So telling that 4th place finisher that a new training program might improve performance 1% would be telling that person that he could be a gold medal winner.

Another issue is that looking at individual results one often sees that some people in the E group will respond to the intervention more than others and some will not improve at all. For instance, in a study with 12 people in the E group, 6 might show improvement and 3 will stay the same and 3 will perform worse. However, the group average will have been increased. If you choose to apply this intervention, you need to understand that not everyone will respond the same to the intervention. This is where coaching becomes an art!

Some researchers will look at all the studies done on a topic and put together a meta-analysis. In essence, this combines the results of a host of smaller studies into one large study where the subject pool might be sufficiently large to draw stronger conclusions or evidence.

**Contradictions**

One of the great frustrations of the lay population is when studies contradict one another. In some cases, it could be dosages were different between the studies or that the populations were different. For instance, a study on iron supplementation might show a benefit while another study does not. The first study used a larger dose and had female subjects; the latter study used half the dosage and used males.

It has been reported that the initial studies are often contradicted by later studies. The early studies often have small sample sizes or use faulty methodology that later studies "fix". Again, look for the preponderance of evidence rather than merely the latest study.

**Summary**

Scientific studies certainly have a role in improving performance, but the world of science moves slowly. It might take 18 months to get a study published once the study itself is completed. Coaches do not have the luxury of waiting that long. Coaches experiment with what works based on what they know about training (some of which is supported by the scientific literature) with each athlete. Every coach knows that applying the same training program to all athletes will result in good outcomes for some, mediocre for others and worse for some. So coaches must use intuition in applying the principles. Coaches have a big advantage over scientists in that coaches do not have to use a control group so they can experiment with an athlete's training.

In short, coaches should be able to critically read scientific research if for no other reason than to be able to assuage the fears of athletes and to educate them as well. **O**

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