

PERFORMANCE ANALYSIS IN RIFLE SHOOTING

PART 1

INTRODUCTION TO TECHNICAL SUCCESS FACTORS

In shooting we very often tend to analyse a performance “through our own lenses” which means that if our eyes see something that we do not like or we are not used to - it cannot be good.

This phenomenon leads to a situation where the performance is analysed often according to the outer position. Naturally position is the platform for a good hold but is that all we need? Do we need something else like good sight alignment and good trigger control in order to do well?

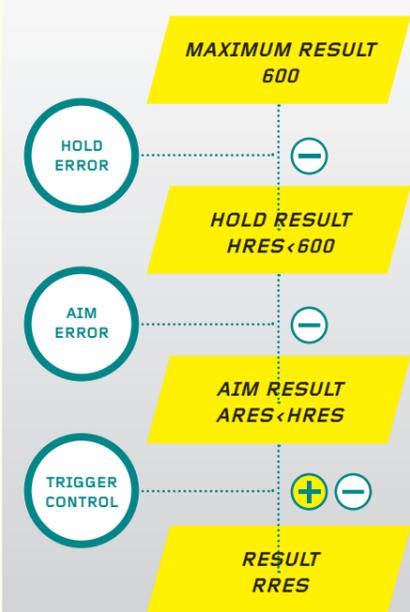
For example, if we take some of the most successful rifle shooters from the recent years and analyse their prone (for example Sergei Martinov) or kneeling position (Rajmond Debevec), many might say that it is impossible to shoot good scores from those positions, indeed that they are incorrect. However one could not be more mistaken. Perhaps it is Martinov and Debevec who are using the correct positions or maybe their other technical qualities are better developed as compared to those of many other shooters. A lot of shooting training is done and analysed from the outer perspective even when we are quite aware that good shooting comes mostly from the inner factors. Especially at an international top level, the differences between holding abilities are not radical. At the end of the day, the factors that determine the score are sight alignment (aiming process) and trigger control. Without any doubt, top level shooters can shoot a ten with every shot and very often it is just a matter of concentration and determination.

This article is based on statistical information and practical coaching knowledge and experience. The data that is shown later comes from a total of 350 series comprising more than 21,000 shots using air guns (air rifle and air pistol) collected from more than 100 shooters ranging from internationally renowned marksmen to untrained amateurs. The data was gathered using Noptel ST 1000 and 2000 optoelectronic shooting devices.



FIGURE 1

>> EFFECT OF SUCCESS FACTORS ON THE SHOOTING RESULT



1. SUCCESS FACTORS

Shooting performance is technically speaking a product of three basic success factors:

- > **HOLD,**
- > **AIM** and
- > **TRIGGER CONTROL.**

A shooter's hold denotes his ability to control his muscles and prevent unwanted movement; his aim denotes the accuracy with which he is able to direct the gun at the desired point on the target; and trigger control denotes the timing of the actual triggering event relative to the hold/aim process and the purity with which the triggering takes place.

1.1. HOLD RESULT, HRES

The above figure can be interpreted in the following manner. In a set of 60 shots, the shooter has the opportunity to score a total of 600 points. Given that the shooter has a non-ideal hold, i.e. the gun is in continuous motion; he or she will lose points in accordance with the degree of this movement, which will reduce the achievable score. This “intermediate result” is referred to here as the hold result, HRES, and can be calculated mathematically from the hold values, i.e. the calculated deviations from the gun orientation path, assuming that the shooter has aimed each shot at the target centre on average (i.e. the shooter's aiming ability is not included in this measurement). In standing and kneeling positions, a common problem is the horizontal movement which can be a result of several things. In standing, the lack of general balance and core-stability in the body and incorrect placement of the rifle vis-à-vis to the centre of gravity of the body are very common causes of problems in the undesired horizontal sway. In kneeling, the tension in the overall position and the location of the centre of gravity too far to the right often cause a large horizontal movement. We will have a closer look at these points in the later articles in the ISSF NEWS.

All tables from the authors

1.2. AIM RESULT, ARES

No shooter is able to aim each shot in such a way that the centre of gravity of the holding area lies precisely at the centre of the target, and consequently the achievable score will decline. This result is known as the aim result, ARES, which will thus always be smaller than the hold result (HRES). The aim result can be calculated mathematically on the basis of holding values calculated from the path and the holding area location data, i.e. the centre of gravity (COG).

Aiming is connected to the holding ability. The better the hold, the better chances the shooter has of aiming at the middle of the target. The common practical problem in aiming is that the shooter is approaching the sharp aiming area from different directions. If the approach is made from a different angle with every shot it is probable that the centre of gravity of aiming will be in a different place every time. The shooter is in this case is trying to learn a different skill shot after shot. Obviously the development can be a lot slower compared to a consistent shot routine where the approach is the same every time.

Another common problem related to aiming is the aiming time which in general tends to be too long. One factor is poor trigger timing, which is a result of a bad hold and poor concentration. Rarely do we see shooters who have ideal aiming times and trigger timing during the whole training session or match. Once it becomes a real problem, overcoming it can take a very long and frustrating time. If the shot is not released in less than 10 seconds from the start of the sharp aiming, the shot must be aborted. Coaches have to be very careful with this feature throughout the whole training process.

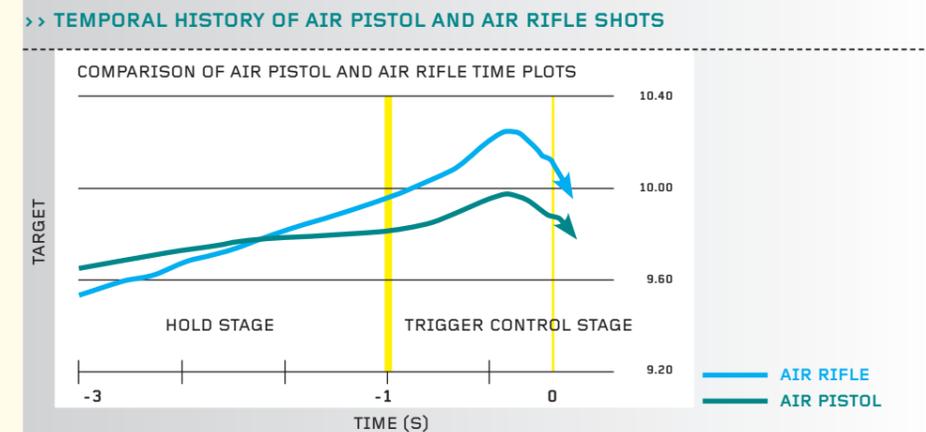
1.3. TRIGGER RESULT, RRES

As mentioned above, trigger control is a factor that enables the shooter to “compensate” for score losses arising from holding and aiming errors. This compensation is mainly based on timing, in that the shooter tries to optimise the triggering point relative to either the aiming picture and/or hold, bearing in mind the average state of these two during the aiming/hold sequence. Even the benefits gained from good timing may be wasted, however, if the actual triggering is not performed properly.

The measurements indicate that practically all shooters make use of optimisation either consciously or subconsciously, although this is particularly the case with reaction shooters.

Figure 2 indicates how an average air rifle or air pistol shot originates during the last three

FIGURE 2



seconds. The vertical axis shows the result and the horizontal is the time. The holding and aiming errors referred to in the model for shooting performance are calculated for the hold stage, and the hold result is calculated on the basis of hold ability only, while the aiming result also involves the average aiming point. The total effect of trigger control can be obtained by subtracting the real result from the aiming result.

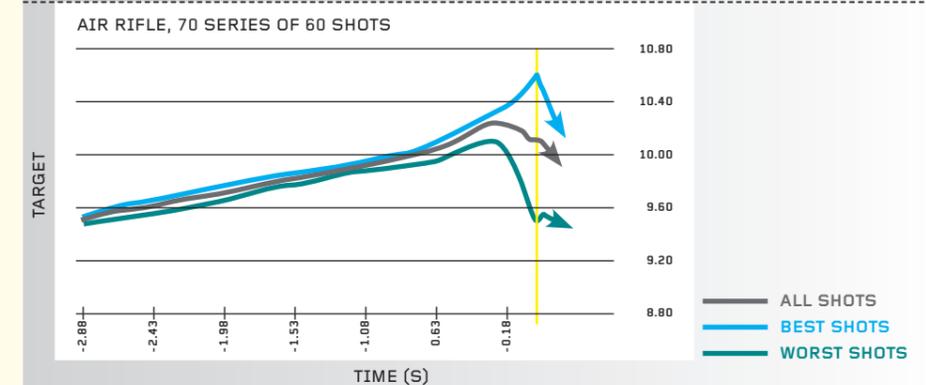
The figure clearly indicates that shooters try to benefit, either consciously or subconsciously, from the timing of triggering, a process referred to here as optimisation. The diagram also confirms our impression of the finite nature of human reaction time, which

This movement is also attributable to the fact that triggering is on average not absolutely clean, as indicated by the fact that the “optimisation peak” is not fully symmetrical. Optimisation is present at all levels of performance, and is considerably greater among rifle shooters, due to the fact that a larger part of the movement of a rifle occurs in the low frequency range (less than 3 Hz), which is easier to control, whereas 40-50% of pistol movement occurs at the extremes of the shooters' reaction ability or completely beyond it.

As seen in Figure 3, the difference a good shot and a poor one arises at the holding

FIGURE 3

>> EVOLUTION OF GOOD AND POOR AIR RIFLE SHOTS WITH TIME



in this case is an average of approximately 0.3 seconds. When a visual cue is obtained that the direction of the gun, i.e. the aim, is good, the shooter ‘decides’ to squeeze the trigger, whereupon it will take approximately 0.3 seconds for the forefinger to bend and the gun to go off. Unfortunately, the gun will have already left its ideal position and the result will be poorer than expected.

stage. The most important factor, however, is the timing of triggering, as the poor scores can be attributed to late triggering.

In training or in competition this can be noted when the shooter carries on with the shot even when aware that it is not going to be a good one. Shot recognition which means recognising a bad shot before firing it is one of the key words in avoiding bad hits. >>

1.4. SHOOTING STYLES

The holding and aiming values are both also dependent on shooting style. The shooters can be divided into three groups: hold shooters, optimising shooters and reaction shooters (i.e. highly optimising shooters). The calculating of holding and aiming ability from values recorded at the holding stage in the manner described in the model means that the hold shooters naturally obtain the best values and reaction shooters the poorest ones. The eventual result may in any case be the same, as reaction shooters tend to gain additional points by virtue of their good trigger control.

Higher relative optimisation values were recorded among the rifle shooters compared to the pistol shooters. However, i.e. most of them made use of timing to compensate for inadequate holding. On the other hand, an evident group of hold shooters was also identified in this case. It would seem on the basis of the test material that the best female shooters have a better hold ability than male shooters, the difference being a matter of vertical hold.

All shooters have different personalities and different shooting styles. It is very difficult to say that only shooting style should be used recommended. In the history of

1.5. CONCLUSIONS FROM PART 1

Instead of "over analysing" the technical contents we should try to simplify the technical model in shooting. Like we all know complexity is not an advantage in the training process. The things that we teach should be easy to understand in case we want someone to learn them easily and well enough.

Basically the technical success in shooting depends only on a couple of things: we have to point the gun in the middle of the target and then squeeze the trigger! If the line from our eye to the target is not in the centre we will not hit the centre. As simple as that! We are aware that kind of approach is very naive but however this is the main point if we want to hit the ten ring.

The next step is to emphasize this in the training process. We need to practise especially these important and relevant things if we want to see some development. Changing the outer position is not always the answer.

We need to have separate training sessions and clear goals for improving hold, aiming process and trigger control. A lot of shooters are obviously shooting in training sessions. Are they training? That is another question.

It is extremely difficult for a human being to concentrate on several tasks at the same time. Therefore we have to concentrate only on one technical topic at a time when we are trying to improve some technical part. Keep it simple – do not add too much!

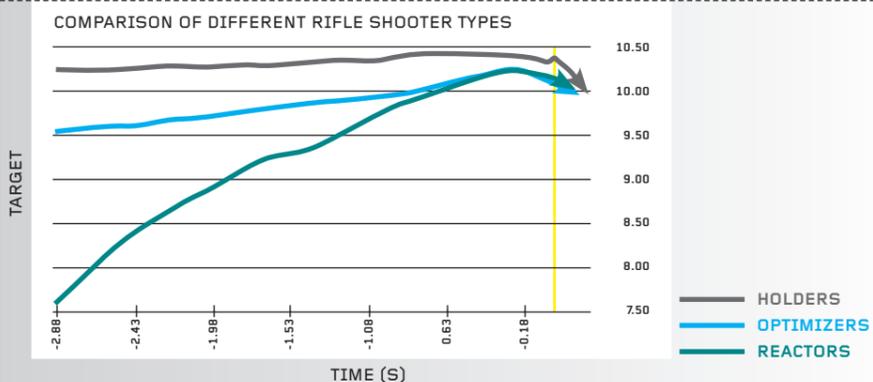
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To be continued ...

FIGURE 4

>> BASIC AIR RIFLE SHOOTING STYLES



Three groups can be distinguished:

- > HOLD SHOOTERS
- > OPTIMISING SHOOTERS
- > REACTION SHOOTERS

This division is based on the amount of relative optimisation, i.e. the optimisation resources that the shooter makes use of. Optimisation resources can be calculated by subtracting the aiming result (ARES) score from 600.

shooting sport it is obvious that all styles have been used by gold medal winners. The "Holders" normally suffer from trigger timing and aiming time problems. Holding the rifle in the ten ring over 10 seconds and then fire a nine is not uncommon. The "Reactors" suffer from sudden bad shots (8's) because of the reactive manner of their performance. If you are sometimes late the shot can go really far. A relatively safe style would be to create a good hold and use a slight optimisation when going in towards the bull's eye.



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