# Development and Application of Pistol Rapid Fire Training Instrument Based on Action Procedure

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**Abstract:** The training efficiency can be improved not only through the innovation of training methods, but also through the research and development of training instrument. Since it is difficult for traditional dry practice to effectively improve the ability of rapid pistol firing, pistol rapid fire training instrument based on action procedure theory is developed. Targeted training on trigger shooting ability can be realized through the research and development of training instrument. According to the law of offset between speed and accuracy in actual combat, thereby minimizing the loss of shooting rate due to rapid trigger pulling in rapid fire event. New instruments have a positive effect on improving the training effect of action control ability according to empirical study.

## 1. Introduction

Air pistol event has always been advantageous in China competitive sports, wherein rapid fire event is also an important event for winning gold medal. Its skills have been widely used in the police pistol shooting skill training with fruitful results. Rapid fire skill is widely used in the actual combat of public security. It is a good skill to fight against dangerous criminal suspects and protect policemen themselves. The control technology of rapid fire trigger is very important about whether a policeman can shoot the other side quickly and ensure his own safety with quick action and superb shooting skill However, it is not easy to master such skill, and a lot of training is required.

Trigger rapid continuous firing action of rapid fire is adopted as an example according to the 'action procedure theory'. The actuator is responsible for evaluating environmental conditions (stimulus confirmation) and deciding whether to make the firing action (response selection) or not in each information processing stage. If the shooter decides to fire, an action procedure is formulated and implemented (response procedure). Then, the control information is then sent to the receptor to perform the action, the action procedure is firstly transmitted to the spinal cord and then to the muscles for contractions. If the firing action (index finger pulling the trigger) achieves the desired result (firing completion), it will produce an effect on environmental condition change (rapid recovery under the requirement of continuous rapid firing). In an open-loop control system, the to-be-contracted muscles, contraction order and time are determined in the action procedure. Various information processing stages are used for formulating action procedures and determining the initial action and its final form (such as action speed and route of the index finger in the trigger shooting). The execution process of index finger rapid-fire action is completed under the condition of no conscious direct participation. The application of action procedure has become more extensive with the increase in practice, which participates in the control of long-time action. They even work together with various reflex activities to serve the overall action goal. These action procedure s are stored in long-time memory once the mechanism is established, which can be extracted and adopted if it is necessary.

## 2. Development and application of pistol rapid fire trigger trainers

### 2.1 Research and development ideas

It is necessary to strengthen targeted training on the action control ability of the last instant released by the index finger after the completion of trigger shooting in the rapid continuous shooting according to the action procedure theory, thereby enhancing the instantaneous fine control ability. It is necessary to manufacture a quick trigger auxiliary trainer, which simulates the minimum distance of completing next bullet loading during return after trigger shooting in the establishment of a live ammunition state, and the accurate distance sense for the trigger stroke released by the index finger is established. It should include a filler block and a clip arm connected to both ends of the filler block. The filler block should be used for filling the trigger stroke chamber, at least a part of its width is less than or equal to the width of the trigger stroke chamber, the bottom of the clip arm should be connected to the side of the filler block, and the top should be adducted to hook the outside area of the pistol. The filler block is installed in the pistol barrel and trigger position for filling the gap outside suitable stroke of the trigger. Briefly, the rapid trigger assistant trainer can effectively shorten the trigger stroke and help the shooter remember the most appropriate return position of the trigger by filling the filler block fixed by clip arm into the trigger stroke chamber, the trigger stoke can be shortened by one-fifth, thereby saving time and improving the shooting speed. The instrument is not only suitable for routine air pistol rapid fire, but also applicable for training of other semi-automatic pistols for military and police after size modification.

The technical scheme of rapid-fire trigger assistant trainer is shown as follows: the trainer includes a filler block and a clip arm connected to both ends of the filler block, wherein the filler block is used for filling the trigger stroke chamber. At least a part of its width is less than or equal to the trigger stroke chamber width. The the bottom of the clip arm is connected to one side of the filler block, and the top is addicted to hook the outside area of the pistol. The thickness of the filler block increases gradually from top to bottom, and the thickness at the bottom of the filler block is 3-4mm. The bottom of the clip arm extends outwards for a certain distance before extending upwards. When there is no external force, the distance between the clip arms is equal to or less than the width of the pistol clipped by the clip arm, and the length of the clip arm is 0.4-0.6cm. The inner side of the clip arm has a non-slip surface, which is made of steel or rigid plastic.

The trigger stroke can be effectively shortened, and the shooter can remember the most appropriate return position of the trigger through filling the trigger stroke chamber with the filler block fixed by the clip arm, which can shorten the trigger stroke by one-fifth, thereby saving time and improving the shooting speed.

### 2.2 Specific implementation mode

(a) shows the schematic diagram of trainer structure;(b) shows the lateral view of the filler block; (c) shows the lateral view of the filler block, wherein a part of the bottom of the filler block exposes out of the trigger stroke chamber; wherein (d) is between installation of rapid-fire trigger auxiliary trainers (f) is after the installation of rapid-fire trigger auxiliary trainers.

Note of attached drawing marks: 1- filler block; 2- clip arm; 3- holding pawl; 4- grip part, 5- barrel sleeve; 6- trigger; 7- gap.

It should be noted that the words in the following description- 'front', 'back', 'left', 'right', 'top' and 'bottom' refer to the directions in the attached figure. The words 'inside' and 'outside' refer to the directions towards or away from the geometric center of a particular part respectively.

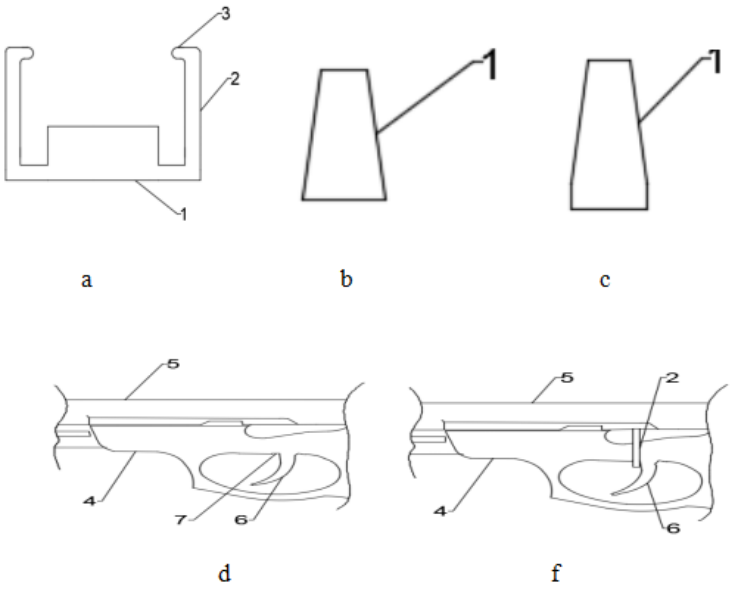


Figure 1. The schematic diagram of a part of the pistol

Type 92 pistol is adopted as an example. Pistol main body includes two major parts: pistol handle component 4 and pistol barrel sleeve 5. The pistol handle component has a trigger stroke chamber, and the trigger 6 can move back and forth in the stroke chamber. The rapid-fire trigger auxiliary trainer provided by the utility model is used for filling the extra gap of the trigger in the stroke chamber without return. (a) Shows that the rapid-fire trigger auxiliary trainer comprises a filler block 1 and a clip arm 2 connected to both ends of the filler block 1. The filler block is used for filling the trigger stroke chamber. The width of the filler block in the stroke chamber should be slightly less than or equal to the width of the trigger stroke chamber so that it can be filled smoothly without shaking. The bottom of the clip arm 2 is connected to one side of the filler block 1, and the top is adducted like a claw. It is a fixed claw 3 for hooking the outside area of the pistol. Because the pistol barrel sleeve is moved back and forth during firing, if the pistol barrel sleeve is clipped by the clip arm, the firing of the pistol will be hindered, the clip arm should not be too long, namely about 0.4-0.6 cm. The clip arm can only clamps the handle part under the pistol barrel sleeve. The fixed claw at the top of the clip arm is located between the handle part and the pistol barrel sleeve. The fixed claw should not be too high, thereby hindering the action of the pistol barrel sleeve.

The thickness of the filler block should be gradually increased from top to bottom, and the filler block is wedge-shaped as a whole. Its side at least is trapezoid on the upper part as shown in (b) or (c). It can be loaded into the stroke chamber easily, and can adapt to the shape inside the stroke chamber. The bottom of the filler block (the bottom here refers to the position where the filler block is flush with the bottom of the stroke chamber when the auxiliary trainer is loaded into the stroke chamber), and the thickness is 3-4mm, which is suitable for the distance that the trigger in the stroke chamber does not need to return.

In addition, since the width of the pistol is wider than the width of the stroke chamber, the bottom of the clip arm is extended outwards for certain distance, and then it can be extended upwards for better holding the outside area of the pistol. The distance between the clip arms should be at least equal to the width of the pistol clamped by the clip arms under the state without external force, and it should be slightly smaller than the pistol width clamped by the clip arm. When the rapid-fire trigger trainer is installed on the pistol, the two clip arms have certain clamping force on the pistol body, and the fixation effect is better. Auxiliary trainers should be made of rigid materials with certain elasticity, such as steel or durable hard composite materials (such as composite plastic), and it has good elasticity, strong clamping force, high strength, excellent wear resistance and good durability. The inner side of the clip arm is preferably provided with an anti-skid layer, and it is not easy to slide on the pistol body. The inner side of the clip arm can be sanded or equipped with raised particles, thereby achieving the anti-skid effect.

The size of the above-mentioned trainer is designed based on type 92 pistol. When the trainer is applied to other types of pistols, the size of the trainer should be re-designed according to the stroke of the pistol trigger and the size of the stroke chamber, thereby being suitable for more types of pistols. When the rapid-fire trigger trainer is used as shown in (d), the filler block is inserted into the outer side of the trigger 6 in the stroke chamber (the direction of pulling the trigger is regarded as inside area, and the opposite direction is regarded as the outside area), the two clip arms 2 are placed outside the pistol body, which is hooked on more protruded position on the pistol handle component. The trigger is pulled quickly during training of rapid-fire, the trigger can be pulled again after it is collided to the filler block during trigger return, thereby shortening the overall stroke of the trigger, effectively improving the design speed, and achieving the best rapid-fire training effect.

### 2.3 Empirical research

36 students from Nanjing Forest Police College majoring in police command and tactics were selected, and then they were divided into two groups by drawing lots before the rapid-fire training, namely 18 students in group A and 18 students in group B. QSZ92 9mm pistol was used for 25m slow-fire examination with 10 bullets before the rapid-fire training. The results are shown in table I.

Table 1. Comparison of 25m Slow Fire Performance before Experiment (N=18)

| | Experiment team (Group A) | | Control team (Group B) | | Value T | Value P | Difference |
|---|---|---|---|---|---|---|---|
| | Average value | Standard deviation | Average value | Standard deviation | | | |
| 25m slow-fire (result) | 78.23 | 11.36 | 79.59 | 12.36 | 0.04 | >0.05 | 无 Significant difference |

There was no significant difference in shooting basis between the 36 students in the experimental team (group A) and the control team (group B) according to the random grouping. Interference factors are reduced for the later experimental control. Concretely speaking, one teacher is responsible for one-term pistol rapid fire training on two groups. A total of 128 class hours are spent. The same syllabus, teaching schedule and teaching methods are applied. The only difference lies in addition of new trainers on pistols of the experiment team (group A). Rapid fire assessment of 10 bullets with a distance of 15 meters is carried out at the end of term. The specific results are shown in table II.

Shooting posture belonged to flat extension with both hands and rapid firing in situ. 10 bullets are shot continuously, and time was counted since the pistol was directed to the target and ended when the tenth bullet was shot. The examination results show that the experimental team result was significantly better than the control team with an average value higher than 4 points. Significant difference was shown. Most importantly, the intervention of the trainer significantly shortened the shooting time, and the average time was shortened by about 2 seconds with a significant difference. Therefore, the ratio coefficient between the experiment team shooting result and average time is higher than that of the control team by 3.54.

The generation of the action mode was timely fed back and corrected in the open loop part formed by the action skill according to the action procedure theory. The action executor was constantly assisted to adjust the action through the feedback process. For example, muscles and joints played their roles in each part in the action. Therefore, the performer encountered a big challenge of identifying the combination capable of producing the most effective action. Namely, the muscles and joints allowing 'free action ' which can be effectively utilized during the action. Meanwhile, some other muscles and joints are inhibited from participation. The main functions of the action procedure

include: these characteristics are relative surface phenomena of the basic action modes according to basic action procedure theory, time and amplitude of action, limbs and muscles for generating the action. These 'surface features' are also known as 'parameters,' namely they are modifiable parts in the basic action procedure. Action executor chooses the parameter value when basic action procedures are used in a specific situation. The intervention of the trainer determines the minimum return distance of the trigger return in the state of unloaded pistol, thereby providing parameter value for the executor of multiple continuous shots. The executor has more practice on the 'parametric' process (increase or decrease of time or range of action, etc.), the executor can better determine the parameter value and make a successful action.

Table 2. 15m quick-fire result comparison after experiment (n=18)

| | Experiment team (Group A) | | Control team (Group B) | | Value T | Value P | Difference |
|---|---|---|---|---|---|---|---|
| | Average value | Standard deviation | Average value | Standard deviation | | | |
| 15m rapid-fire (result) | 84.33 | 12.75 | 80.14 | 14.63 | 2.791 | <0.05 | Significant difference |
| Time (second) | 6.44 | 1.84 | 8.39 | 2.89 | 1.456 | <0.05 | Significant difference |
| Result/time | 13.09 | | 9.55 | | | | |

Modern military and police training follows the general idea of 'absolute fast speed and relative accuracy'. The requirement of 'fast speed' for rapid fire is obviously higher than that of 'accuracy'. The minimum distance of bullet loading is accurately fixed by the trainers. The problem of ‘fast speed’ is solved on the one hand, the accuracy requirement is better fit by constant repeated fixation distance and construction of action procedure in the rapid-fire unloaded practice stage, therefore it is more in line with the current police actual combat as well as the guiding ideology and development trend in the field of military combat.

## 3. Application and promotion value of new trainer

Pistol rapid fire skill has been gradually emphasized at present. Firstly, the number of attacks on policemen is increasing in the field of actual police combat due to prominent social contradictions. The number of police casualties remains high. Pistol rapid fire technique is used skillfully, and it has become the last defense line of safety law enforcement during actual police combat of public security police. Secondly, the global counter-terrorism situation is constantly changing and the extremist group IS is spreading in the field of counter-terrorism from the perspective of the international situation. [12] China's anti-terrorism situation is increasingly serious due to influence of 'East Turkistan Islamic Action ', 'East Turkistan' and other foreign forces. Pistol rapid fire skill has become the core course in the training process of anti-terrorism talents with the goal of serving national security and stability. Thirdly, pistol rapid fire event is also an advantageous event winning gold medal for China in the field of competitive sports. How to keep the advantages continuously is also a test for the overall level of competitive sports in China. The pistol rapid fire special action ability training process is divided into flow of harmonious interaction and integration of action modes at different levels according to training on the basis of the action procedure and intervention of auxiliary trainers. The technical training is converted into body foundation power posture and action training. The body execution action is more natural and relatively simple. Special basic action model training at the microcosmic level is mainly strengthened, the training efficiency is increased

significantly, and the effect is obviously better than the traditional method. The application of novel trainers belongs to powerful exploration on specific cognitive fast response and action ability training. The requirements on intelligence factors such as training object cognition, judgment, etc. can be improved in the process of application and promotion. The ability of training objects' central nervous system should be improved for rapid judgment, selection, decision, extraction and execution of various general action procedures. The training efficiency can be effectively improved, the training cycle can be shortened, and the expected training effect can be achieved.

## 4. Application and promotion value of new trainer

The action procedure theory is utilized. Rapid-fire trigger auxiliary trainers are involved. The empirical research shows that muscle memory is formed through certain repeated training since the trainer can effectively shorten the actual stroke of the shooting trigger in the continuous rapid fire process of multiple bullets, thereby assisting shooters to remember the most suitable return position of triggers, saving time, and improving the shooting speed. In addition, the instrument is not only suitable for various semi-automatic pistols for military and police, but also applicable for conventional air pistol rapid fire training after size modification.

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