Pattern Testing – ATA Singles using Full versus Modified versus Improved Cylinder

When I first started shooting trap with my old Zoli, I started with a Modified Choke, and did pretty well with it. Turns out, I didn't learn until much later when I got a bore micrometer, that it was really an Improved Modified choke.

Prompted by a lot of *"porch talk wisdom"* about which is the right choke to use for singles, I took it upon myself to see what the patterns tell us.

Incidentally, this has all been done before. Dr A C Jones in his excellent book Sporting Shotgun Performance, covers this in much more detail than I am about to, and he adds in the "shooter's ability" to the mixture. I am not that ambitious. I just wanted to see what the "tea leaves" tell us, so to speak.

There appear to two groups, each with their firmly held belief, that one choke is superior to the other in terms of pattern performance when shooting singles. One group insists a full choke will give you better breaks, better feedback on your breaks, and in the long run, better scores.

The other school of thought is that the modified choke gives a bigger pattern and has "enough" pattern density to get the job done at singles, without the fear of missing a target because your pattern is too tight. Frequently I hear (or read) "if a tighter choke is better, why don't we all shoot .22 rimfire???" Which is absurd…

So, on Thursday the 20th of June 2024 I went off to my nearby range to pattern full and modified, and just for fun, a choke that is marked Improved Cylinder, but is a little light, being somewhere between Improved Cylinder and Skeet. Why? Just for fun. And one of my friends from South Africa shoots a very open choke and shoots well with it.

The reason I chose the ammunition I chose is that this is the kind of ammo one would expect average Joe Trapshooter, who doesn't reload, will go to the sporting goods store and buy to use for singles, AND they'll put in a modified choke and think it will help them break more targets.

So here are the particulars:

- Gun: Zoli Z-Trap Unsingle
- Ammunition: Remington Gun Club Light 8's, 1-1/8 ounces of Number 8 shot at 1145 fps (very soft shot)
- Pellet Count: 495 (I checked 4 shells before testing and 2 more afterwards, and the numbers were consistent)
- Yardage: 35 yards measured by tape measure, thought to be typical of the yardage from the shooter that singles targets are broken

- Chokes: Factory Zoli Extended - Full @ 0.038” / Modified @ 0.021” / IC @ 0.008”
- Temperature upper 80’s and humid

Ten patterns were shot with each choke. The patterns were shot onto 48" x 48" paper. Digital high-resolution photographs were taken of the paper and analyzed using Shotgun Insight, a computer program developed by Dr. A. C. Jones.

All of the individual pattern efficiency graphs have been ordered lowest to highest according to that pattern’s PE (Pattern Efficiency.) Because of the large difference in pattern efficiencies, the IC graph scale is skewed lower.

Before we talk about results, let’s talk about some things that we need to accept as “almost probably absolutely true.”

- Good barrels and good chokes almost always pattern the same, when using ammunition with the same pellet hardness, and using the same choke constriction. Neil’s testing, Dr. Jones’ testing, and my testing have shown this to be the case. So, this test should be pretty representative of the kinds of guns and choke tubes most trap shooters are using.
- Hard shot patterns tighter than soft shot. Neil’s testing, Dr. Jones’ testing, and my testing have shown this to be the case. The PE’s below would be higher with harder shot.
- Atmospheric/elevation changes will affect results, so doing this kind of test in Vernal, Utah on a hot, humid day will bear different PE results than doing this kind of test in Portland, Maine on a cold, dry day. (I say this in case someone later tries to re-create this test and finds the numbers are different.)

Now let’s talk about the results. The overall pattern percentage, or pattern efficiency (hereinafter referred to as “PE”) came in with no surprises.

- Full Choke PE, Average over 10 shots – 79.6%
- Modified Choke PE, Average over 10 shots – 73.0%
- Improved Cylinder Choke PE, Average over 10 shots – 49.6%

There is a little overlap among the highest Modified Choke PE’s and the lowest Full Choke PE’s, which you’ll see discussed below.

Again, these PE numbers would all be higher if I had used premium ammunition with harder shot.

I don’t think anyone will be surprised to learn that the “hot core” of the full choke is hotter than the other two.

- Pellets in the 10” Pattern Core, Full, Average – 91
- Pellets in the 10” Pattern Core, Modified, Average – 81
- Pellets in the 10” Pattern Core, Improved Cylinder, Average – 39

And I don't think anyone will be surprised to learn that the "mid" area, that is the annular area between the 10" core and the 20" circle, will have more pellets with the full choke than the other two.

- Pellets in the 10"-20" middle annular ring, Full, Average – 172
- Pellets in the 10"-20" middle annular ring, Modified, Average – 147
- Pellets in the 10"-20" middle annular ring, Improved Cylinder, Average – 99

But here's where it gets interesting. Most people would suggest that there should be MORE pellets in that outer ring with the Modified choke and the Improved Cylinder choke, than with the Full choke. Because, after all, that's why you want a modified choke…when your gun pointing skills are a little off and you want that outer ring working for you.

WRONG! On average, there are exactly as many pellets in this area of the full choke pattern as there are in the modified choke pattern. And WAY fewer with the improved cylinder.

- Pellets in the 20"-30" outer annular ring, Full, Average – 132
- Pellets in the 20"-30" outer annular ring, Modified, Average – 133
- Pellets in the 20"-30" outer annular ring, Improved Cylinder, Average – 108

Interesting! Kinda flies in the face of the porch talk wisdom, doesn't it? So if you are someone who regularly puts the center of the pattern within 15" or so of the target, a modified choke will do you absolutely not good.

So, now that we've talked about what's going on inside the 30" circle, let's look at how many pellets are left outside the 30" circle.

- Pellets outside the 30" circle, Full, Average – 101
- Pellets outside the 30" circle, Modified, Average – 134
- Pellets outside the 30" circle, Improved Cylinder, Average – 249

This leaves us with a dilemma. How do we establish the effectiveness of these pellets outside the 30" circle? Well, since Shotgun Insight doesn't pay any attention to them, let's do a thought experiment. Let's assume (and this is a really bad assumption) that ALL of those pellets outside the 30" circle fall between the 30" circle and an assumed 40" circle. Now what? Now we have a full choke with 101 pellets in the 30" to 40" annular area, a modified choke with 134 pellets in that annular area, and an improved cylinder choke with 249 pellets in that annular area, on average.

With those numbers, you would end up with, assuming they are evenly spaced (and they're not) 1 pellet every 5.4 square inches with the full choke, 1 pellet every 4.1 square inches with the modified choke, and 1 pellet every 2.2 square inches with the improved cylinder choke.

If what happens outside of the 30" circle is important to you, you might choose the improved cylinder choke based on those criteria. And in fact, that's a poor criterion to use. If you have a lot of pellets OUTSIDE the 30" circle, you probably don't have enough INSIDE the 30" circle. In my opinion, the probability of multiple pellet strikes on a target that is more than 15" away from the center of the pattern, regardless of which choke you choose, is extremely low. There's just not enough pattern density out there to do you any good. And there's really not that much difference between the full and the modified choke, out there outside the 30" circle, to say one is a benefit as opposed to the other. But with the tools I have available to me, I can't prove it. And yes, I know a single pellet strike CAN break a target. But the probabilities are much lower than multiple pellet strikes.

Now let's look at pattern diameter. Shotgun Insight has a feature that tells us the diameter of a circle that would contain 75% of the pellets. That's not "exactly" the same as the overall effective pattern diameter, but it's probably pretty close.

- 75% diameter, Full Choke, Average, 26.4 inches
- 75% diameter, Modified Choke, Average, 28.4 inches
- 75% diameter, Improved Cylinder Choke, Average 35.4

So those of you who are sure that a modified choke gives you a much bigger pattern…WRONG. Only an extra inch all around the circle. As a friend of mine is fond of saying, *"patterns are measured in inches…"*

Another interesting thing that some of you who have paid attention to Neil and I when we publish these pattern testing results is the range of the PE's within a group of 10 patterns shot. It is almost always 10% and sometimes more. These results are in line with that.

We've been talking above about averages, but let's look at the lowest and highest PE's of each, summarized here:

- PE, Full, Lowest – 76.0%
- PE, Full, Highest – 85.9%
- PE, Modified, Lowest – 67.5%
- PE, Modified, Highest – 76.4%
- PE, Improved Cylinder, Lowest – 40.8%
- PE, Improved Cylinder, Highest – 55.6%

So, to summarize:

Those of you who think an Improved Cylinder choke is all you need for 16-yard ATA Trap Singles, you're probably missing targets even though you are pointing your gun perfectly. Based on these results, it's a poor choice.

Those of you who think a modified choke is totally unsuitable for 16-yard ATA Trap Singles because it doesn't have enough pattern density, are wrong. The pattern density shown in the testing is "good enough." And would be even better if you use premium ammunition, which would increase those PE's (as shown in previous testing I have done.)

Those of you who think you are putting yourself at a disadvantage by using a full choke for 16-yard ATA Trap Singles because the pattern is so much smaller, are also wrong. A full choke is an excellent choice. It's no wonder Leo Harrison III recommended it so highly.

Those of you who think using a modified choke for 16-yard ATA Trap Singles because your pointing skills are "still developing" and you think it will get you a target here or there that you wouldn't have gotten with a full choke, are also wrong. The average size of the pattern is almost the same size between full and modified.

Choice of choke is one of the most talked about things at trap clubs, and a favorite among the people who sit on the porch and opine about trap shooting wisdom. Choke choice is probably number 47 on the list of things that are important, especially when talking about singles.

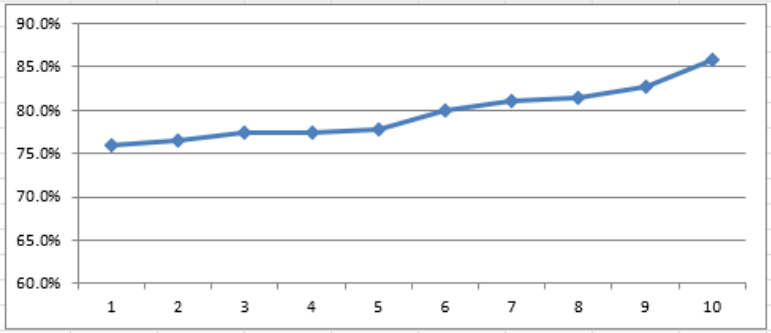
Don't try to buy a target by using a more open choke. It's a waste of time. Improve your gun pointing skills if you want better scores.

I, for one, am going to stick to my 0.042" choke for singles and handicap.

For the good of the sport!

Pattern Testing / FULL Choke / 35 Yards / Remington Gun Club Light 8's / 20 June 2024

Pattern Number	10"	10-20"	20-30"	Total	75%	Pattern Percentage in 30" Circle @ 35 Yard	Central Thickening	
8	85	158	133	376	27.7	76.0%	1.83	1
6	70	164	145	379	27.9	76.6%	1.61	2
2	103	145	135	383	26.3	77.4%	1.84	3
5	85	167	131	383	26.9	77.4%	1.92	4
1	77	180	128	385	26.9	77.8%	2.01	5
3	89	166	141	396	26.6	80.0%	1.81	6
7	94	178	129	401	26.0	81.0%	2.11	7
4	82	202	119	403	26.1	81.4%	2.39	8
9	114	177	118	409	24.2	82.6%	2.47	9
10	108	178	139	425	25.1	85.9%	2.06	10
Average	91	172	132	394	26.4	79.6%	1.99	

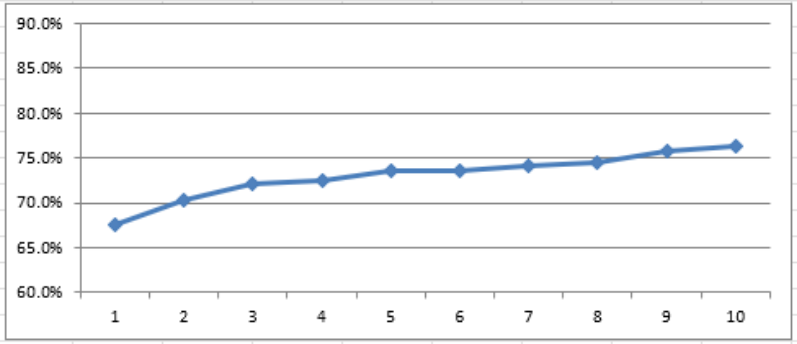


Gun: Zoli Z-Trap Combo Unsingle
Ammunition: Remington Gun Club Light Target 1-1/8 ounce 8's @ 1145 fps
Location: Tri-County Rod and Gun Club - Bonner Springs, KS
Coordinates: 39° 2' 31.62" N, 95° 0' 32.19" W
Elevation: 955 feet above MSL (approximate, from Google Earth)
Time: Start approximately 0945, Finish 1045
Start Conditions: 83F, 80% RH, 92% STD Density, Press 29.35 in Hg
End Conditions: 84.5F, 80.2% RH, 92% STD Density, 29.35 in Hg
Actual Yardage of Test Patterns: 35 yards
Pellets in Shells: Average 495
Choke: Zoli Factory Extended Marked Extra Full
Barrel Bore: 0.729"
Choke Bore: 0.691"
Constriction: 0.038"

				Avg Pellet Density, Pellets per square inch	
Area	10"	79	sq. in.	1.15	
Area	10"-20"	236	sq. in.	0.73	
Area	20"-30"	393	sq. in.	0.34	
Average Number of Pellets Outside the 30" circle		101			
Area, assumed	30"-40"	550	sq. in.	0.18	5.4

Pattern Testing / MODIFIED Choke / 35 Yards / Remington Gun Club Light 8's / 20 June 2024

Pattern Number	10"	10-20"	20-30"	Total	75%	Pattern Percentage in 30" Circle @ 35 Yard	Central Thickening	
4	65	156	113	334	29.4	67.5%	1.96	1
6	64	143	141	348	30.1	70.3%	1.47	2
7	95	134	128	357	27.9	72.1%	1.79	3
5	84	138	137	359	28.8	72.5%	1.62	4
9	82	165	117	364	26.8	73.5%	2.11	5
10	72	141	151	364	29.6	73.5%	1.41	6
2	86	139	142	367	27.8	74.1%	1.58	7
1	73	154	142	369	28.6	74.5%	1.60	8
3	94	146	135	375	27.4	75.8%	1.78	9
8	97	153	128	378	27.4	76.4%	1.95	10
Average	81	147	133	362	28.4	73.0%	1.71	



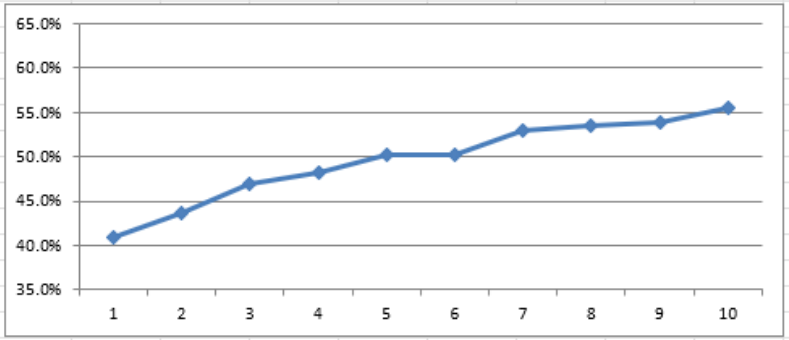
Gun: Zoli Z-Trap Combo Unsingle
Ammunition: Remington Gun Club Light Target 1-1/8 ounce 8's @ 1145 fps
Location: Tri-County Rod and Gun Club - Bonner Springs, KS
Coordinates: 39° 2' 31.62" N, 95° 0' 32.19" W
Elevation: 955 feet above MSL (approximate, from Google Earth)
Time: Start approximately 1045, Finish 1135
Start Conditions: 84.5F, 80.2% RH, 92% STD Density, Press 29.35 in Hg
End Conditions: 86.1F, 78.5% RH, 92% STD Density, 29.36 in Hg
Actual Yardage of Test Patterns: 35 yards
Pellets in Shells: Average 495
Choke: Zoli Factory Extended Marked Light Improved Modified
Barrel Bore: 0.729"
Choke Bore: 0.708"
Constriction: 0.021"

Average Number of Pellets Outside the 30" circle 134

				Avg Pellet Density, Pellets per square inch	
Area	10"	79	sq. in.	1.03	
Area	10"-20"	236	sq. in.	0.62	
Area	20"-30"	393	sq. in.	0.34	
Area, assumed	30"-40"	550	sq. in.	0.24	4.1

Pattern Testing / IMPROVED CYLINDER Choke / 35 Yards / Remington Gun Club Light 8's / 20 June 2024

Pattern Number	10"	10-20"	20-30"	Total	75%	Pattern Percentage in 30" Circle @ 35 Yard	Central Thickening	
9	38	76	88	202	37.7	40.8%	1.30	1
8	29	88	99	216	37.8	43.6%	1.18	2
1	28	95	109	232	38.4	46.9%	1.13	3
4	35	93	111	239	29.4	48.3%	1.15	4
3	53	82	114	249	35.6	50.3%	1.18	5
5	40	97	112	249	36.1	50.3%	1.22	6
2	38	109	115	262	35.0	52.9%	1.28	7
6	47	116	102	265	34.3	53.5%	1.60	8
7	42	118	107	267	34.9	53.9%	1.50	9
10	42	112	121	275	35.3	55.6%	1.27	10
Average	39	99	108	246	35.4	49.6%	1.28	



Gun: Zoli Z-Trap Combo Unsingle
Ammunition: Remington Gun Club Light Target 1-1/8 ounce 8's @ 1145 fps
Location: Tri-County Rod and Gun Club - Bonner Springs, KS
Coordinates: 39° 2' 31.62" N, 95° 0' 32.19" W
Elevation: 955 feet above MSL (approximate, from Google Earth)
Time: Start approximately 1135, Finish 1230
Start Conditions: 86.1F, 78.5% RH, 92% STD Density, Press 29.36 in Hg
End Conditions: 89.2F, 75.3% RH, 91% STD Density, 29.35 in Hg
Actual Yardage of Test Patterns: 35 yards
Pellets in Shells: Average 495
Choke: Zoli Factory Extended Marked Improved Cylinder
Barrel Bore: 0.729"
Choke Bore: 0.721"
Constriction: 0.008"

Average Number of Pellets Outside the 30" circle: 249

				Avg Pellet Density, Pellets per square inch	
Area	10"	79	sq. in.	0.50	
Area	10"-20"	236	sq. in.	0.42	
Area	20"-30"	393	sq. in.	0.27	
Area, assumed	30"-40"	550	sq. in.	0.45	2.2