Introduction

Velocity Based Training (VBT) is a training method which uses an accelerometer to measure the velocity of a bar, dumbbell, or other object of your choice. With advances in gym technology such as Tendo Units, GymAware, Push Strength, and other accelerometers, coaches now have the ability to monitor, test, and train athletes in a manner allowing the coach to receive objective feedback of certain high demand training affects. With the works of Yuri Verkhoshansky, Louie Simmons and Westside Barbell, Bryan Mann, Mladen Jovanovic, Carl Valle, Dan Baker, and other elite coaches, we have a vast amount of information to aid in the application of this tool and method to maximize the training results and experiences for the athlete.

The article contents is intended to describe the different strength qualities and how they are measured in order to educate coaches on VBT implementation to optimize training program results; this is a compilation of my own experiences and opinions, not belonging to any other company or entity.

Strength Qualities

Yuri Verkhoshansky has been a large influence on many elite level training programs. Whether we realize it or not, leading programs have been swayed by his work as today’s top professionals refer to Yuri’s principles. He chooses to break down strength qualities into the following components: Maximal Strength, High-Speed Strength, Explosive Strength, Starting Strength, Reactive Ability, Local Muscular Endurance, and Maximal Anaerobic Power. All of the components have their own distinct definition, but many others and I summarize them into Max Strength, Strength Speed, Speed Strength, and Explosive Strength.

1. Max Strength – Characterized as a very high load moving at a very low velocity. The objective is to move a considerable load with no limits on time.
2. Strength Speed – High load moving at a moderate velocity. The goal is to move a considerable load as fast as possible.
3. Speed Strength – Moderate load moving at a very high velocity.
4. Explosive or Starting Strength – Light load moving at a very high velocity.

Some may disagree with my terms, loads, and speeds, but this is what I use in my setting.

<table>
<thead>
<tr>
<th>Strength Qualities</th>
<th>%RM</th>
<th>Bar Speed (m/s)</th>
<th>Reps/Sets</th>
<th>Optimal Work Volume</th>
<th>Volume Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosive Strength</td>
<td>&lt;30%</td>
<td>&gt;1.5</td>
<td>4-8</td>
<td>24 reps</td>
<td>18-30</td>
</tr>
<tr>
<td>Speed Strength</td>
<td>30-50%</td>
<td>1.5-0.75</td>
<td>3-6</td>
<td>18 reps</td>
<td>12-24</td>
</tr>
<tr>
<td>Strength Speed</td>
<td>50-80%</td>
<td>0.75-0.5</td>
<td>2-4</td>
<td>15 reps</td>
<td>10-20</td>
</tr>
<tr>
<td>Max Strength</td>
<td>&gt;85%</td>
<td>&lt;0.5</td>
<td>1-2</td>
<td>7 reps</td>
<td>4-10</td>
</tr>
</tbody>
</table>

* use bar speed to determine %RM

<table>
<thead>
<tr>
<th>Max Power Olympic Lift Bar Speeds (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Clean</td>
</tr>
<tr>
<td>Hang Clean</td>
</tr>
<tr>
<td>Power Snatch</td>
</tr>
<tr>
<td>Hang Snatch</td>
</tr>
</tbody>
</table>
Things to Consider

Needs Analysis

It is imperative for every strength coach and performance specialist to sit down and write a needs analysis for their athletes. The analysis list should describe the diverse demands that a sport will impose upon an athlete during competition. For example, a hockey player needs quickness for acceleration and changing directions, power for shooting the puck, strength for fighting for a puck or holding someone against the wall, some hypertrophy to absorb and apply force, mobility and stability in the joints in an alternating fashion, and energy system development for sustaining optimal performance during play. There are considerably diverse demands in hockey when compared to those of golf, which may only need power during the club swing and mobility and stability of the joints in an interchanging manner. Different sports often means different demands.

Strength / Speed Continuum

The Absolute Strength Absolute Speed Continuum is a visual representation of the relationship between load and velocity. The higher the load, the slower the velocity; inversely, the lighter the load, the higher the velocity or speed. It is my belief that an athlete needs to address both ends of the spectrum, but whether you choose to do 1RM training / testing or not is up to you.

On the far left end of the spectrum you have your sprints, jumps, and throws. On the far right is your high intensity loads and exercises such as squats and deadlifts. Then there is everywhere in the middle of the continuum. A lot of coaches choose to utilize Olympic Lifts and the Dynamic Method with their strength exercises to fill in the gap between the two ends of the continuum; this is however dependent on you as a coach to figure out what methods to use and your setting, as long as the velocity matches with the strength quality you are training.

The following is a great video I use to refresh my understanding of Eric Cressey’s description of the Absolute Strength Absolute Speed Continuum.

**Absolute Speed Absolute Strength Continuum**

Criteria for Dynamic Correspondence

Anatoliy Bondarchuk is a former Russian Olympian thrower who won numerous medals. After his athletic career had ended and he transitioned into coaching, he spent many years
researching how different exercises transferred to training and their correlation to enhancing performance during competition. During his years of research, he assisted in developing a criteria which helped determine the validity of certain exercise transference to sport.  

**Understand the application of his research!** Be able to take his findings and apply it to your athletes in your setting! Bondarchuk’s athletes were predominantly elite Olympic throwers, their only job was to throw and their sport only has one need or demand, opposed to team sports which have multiple demands. This is called the *criteria of dynamic correspondence*.  

*Criteria for Dynamic Correspondence:*

- The Amplitude and Direction of Movement
- The Accentuated region of Force Production
- The Dynamic of the Effort
- The Rate and Time of Maximum Force Production
- The Regime of Muscular Work

I believe this criteria to be an important component to understand. As an athlete approaches the start of a season or is trying to peak for events towards the end of the season, such as in track and field or swimming, the velocity or amplitude and direction of movement should change. An athlete cannot spend all year working on maximum strength, the amplitude of the movements are too slow, resulting in limited training transfer. You would be training the nervous system to move slow. A sprinter and thrower in track and field need to be able to take the strength they have developed during offseason training and express that same strength and power at a faster rate as they continue to peak for big events throughout the season. A hockey athlete for example may need to continue to train the Strength Speed (60-80% intensity) quality for most of the season without needing to address the Explosive Strength (<30% intensity) quality because they need to continue to express that high load at a high velocity due to unique demands of the sport.

**Why I use Velocity to Determine Load**

There are many ways to progress athletes when you develop a program. You can manipulate either A) ↑ load or intensity, B) ↑ repetitions, C) ↑ number of sets, D) tempos or time under tension, E) stance or posture, F) the tool or implementation, and/or G) ↑ or ↓ velocity.

Many coaches base the intensity percentages upon an athlete’s 1RM or repetition max; there is nothing wrong with this approach, but some coaches feel they can achieve the same goal of determining a 1RM based upon submaximal repetitions and relative intensity, such as RM+2 or velocity. All approaches have pros and cons. In my setting and my scenario, I choose not to test a 1RM.

So how do I know what intensity a load is for a given athlete?

Using the Prilepin Chart above, you can get pretty close to the intensity percentage or strength quality you want the athletes to train at by using velocity measurements. By using the intensity
and velocity of the movement, you can also identify if you are training the appropriate strength quality in your macrocycle relative to the time of year.

Understanding at what velocity athletes are training is an important component to training. There are a lot of different sports with many different demands, which is not a new realization. Understanding velocity can make you and the athlete certain that you are training the right quality at the right time during the macrocycle.

We are able to ensure we are training the right quality at the proper time of year via VBT. Coaches are in a constant battle with the issue of athlete motivation, for some athletes just do not want to give 100% effort. By using VBT we are now able to give them instant objective feedback as to how much harder or how much faster they need to move the weight, which can be used as a motivational tactic for an individual athlete, or set it up as a competition in a team or group setting. No athlete wants to be the slowest to execute a lift. VBT also provides the coach feedback into the readiness of the athlete. An athlete may completely destroy the velocity of a clean one day, but then get crushed by the same weight and move significantly slower the next training session. VBT feedback will make you able to determine an appropriate weight to select for an athlete to match the given velocity the coach defines.

**How to Use VBT**

There are different methods to adjust or progress a program. The following are different methods outlined in Bryan Mann’s *Developing Explosive Athletes: Use of Velocity Based Training in Training Athletes*.

- **Ascending / Descending Loads, Adjust Each Set, Velocity Stays the Same.** There can be days or weeks where an athlete is just off; this is your traditional progressive overload, but it is important to make sure not to allow the load to slow the velocity below the specified velocity. You can track the trends week to week to display progress.

- **Determined Load and Number of Sets, Velocity Stays the Same.** The athlete will lift a specific load at a specific velocity for each set. If you have programmed 4 sets of an exercise, the athlete will continue to execute as many reps as possible at the given velocity. Once the velocity drops below the allowed speed, the set ends. See if the athlete can execute more reps on the next set. You can display progress by the number of repetitions performed for 4 sets from week to week.

- **Same Weight and Repetitions, Multiple Sets Until There is a Drop Off.** An athlete will execute a specific load for a specific number of reps. If you have programmed 3 repetitions, the athlete will continue to complete as many sets of 3 reps as possible until there is a specified drop off in velocity. You can display the progress by tracking the number of sets completed from week to week.
Examples

The athlete in the video below is using a GymAware unit to measure bar speed. The load stays the same each week, but we tracked the velocity at the given load to monitor speed improvement. The objective in the given example is to beat the velocity from the previous sets.

**GymAware Sample**

An additional example is a 19 year old 100m & 200m sprinter who trained with us using a 3 day split with a different emphasis each day. His program called for descending reps from week to week in a 4, 3, 2, 1 fashion, performing a Split Jerk on day 2 during his first combo. The following table indicates that he was able to increase his weight while at least maintaining, if not increasing speed from the previous week. Athletes love to hear feedback on how they not only improved on strength, but also speed. The bold numbers represent his fastest sets of the given day.

<table>
<thead>
<tr>
<th>Reps</th>
<th>Load / Speed</th>
<th>Reps</th>
<th>Load / Speed</th>
<th>Reps</th>
<th>Load / Speed</th>
<th>Reps</th>
<th>Load / Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Week 1</td>
<td></td>
<td>Week 2</td>
<td></td>
<td>Week 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>135 / 1.36</td>
<td>5</td>
<td>145 / 1.28</td>
<td>4</td>
<td>150 / 1.22</td>
<td>3</td>
<td>155 / 1.30</td>
</tr>
<tr>
<td>4</td>
<td>145 / 1.40</td>
<td>3</td>
<td>145 / 1.42</td>
<td>2</td>
<td>150 / 1.42</td>
<td>2</td>
<td>155 / 1.38</td>
</tr>
<tr>
<td>4</td>
<td>155 / 1.20</td>
<td>3</td>
<td>145 / 1.30</td>
<td>2</td>
<td>150 / 1.48</td>
<td>1</td>
<td>155 / 1.46</td>
</tr>
<tr>
<td></td>
<td>145 / 1.50</td>
<td>2</td>
<td>150 / 1.46</td>
<td>1</td>
<td>155 / 1.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion**

There is a time and a place for VBT, in some cases or times of year it can be useful and effective, while at other times of year or scenarios it may not be as beneficial. It all depends on your program, budget, buy in from the athletes, and if the three E’s are present (effective, efficient, and ethical). It is important to figure out if VBT is for you and which method or device works best in your setting. You just have to use it and figure out what works best for you.

One resource no coach can afford to waste is time, it is our most valuable and limited asset. VBT is one method to utilize with the limited time available in order to create the most effective training program possible.

I would like to thank these coaches in providing the research and resources to help develop, mentor, and educate me throughout my career, and for providing me material to formulate this article. Without these coaches’ willingness to share their knowledge and experience, we would not have as many tools and resources at our disposal to aid in training athletes and be an effective coach in the sports performance field. I would like to thank the late Yuri Verkhoshansky, Bryan Mann, Mladen Jovanovic, Louie Simmons, Carl Valle, Dan Baker, Frank Wintrich, David Trevino, Cal Dietz, Bryan McCall, Joshua York, Brian Abadie, and Lance Walker.