



2022 NSCA *NATIONAL* CONFERENCE

July 6-9, 2022 | New Orleans & Online
#NSCACon22

› *KNOWLEDGE*
› *ADVANCEMENT*
› *COMMUNITY*

CONFLICT OF INTEREST STATEMENT

I have no actual or potential conflict of interest
in relation to this presentation.

My Background

- Bkin – University of Regina (High Performance Specialization)
- MSc – University of Regina
 - Thesis: **Rating of Perceived Exertion and Velocity Relationships Among Trained Males and Females in the Front Squat and Hexagonal Bar Deadlift**
- U of R Asst S&C Coach football, Head for men's hockey and basketball
- 2 years as Head S&C Iowa Wild (AHL)
- 1 year as LA Kings (NHL) Asst S&C (Last year covered the Ontario Reign in the AHL)
- First year full time with the Kings

Outline

- Define Autoregulation, RPE and VBT
- Research on RPE and VBT and their relationship with each other
- How VBL differs from VBT
- Research on autoregulatory methods and how they compare to fixed methods of loading
- My research on VBT and RPE
- Practical application of RPE and VBT with examples

What is Autoregulation?

Autoregulation is a systematic approach of incorporating elements of individualization into a periodized plan.

(Helms, 2016)

Autoregulation is described as training that adjusts to the athlete's performance to allow improvement at an individualized pace to optimize adaptation.

(Mann et al., 2010)

Why the need for Autoregulation?

A large inter-individual number of repetitions an individual can perform at given percentage of 1RM has been observed.

- Cooke et al. found a range of 7-26 repetitions at 70% 1RM in the back squat (2019).
- Odgers et al. found a range of 6-14 repetitions at 80% 1RM in the front squat (FS) and high-handle hexagonal bar deadlift (HHBD, 2021).

EX: 3x8x80% could have athlete A failing on rep 6 and athlete B leaving 6 repetitions in reserve (RIR)

2 Forms of Autoregulation

RPE

Rating of Perceived Exertion (RPE) based on RIR was first validated and published by Zourdos et al., (2016) whereby a RPE of 10 corresponds to 1 RIR, RPE 9 to 1 RIR and so on.

In my research, well trained individuals were able to predict when they had 4 RIR within +/- 1 rep and within 0.2 reps with 1 RIR in the FS and HHBD

RESISTANCE EXERCISE-SPECIFIC RATING OF PERCEIVED EXERTION (RPE)	
Rating	Description of Perceived Exertion
10	Maximum effort
9.5	No further repetitions but could increase load
9	1 repetition remaining
8.5	1-2 repetitions remaining
8	2 repetitions remaining
7.5	2-3 repetitions remaining
7	3 repetitions remaining
5-6	4-6 repetitions remaining
3-4	Light effort
1-2	Little to no effort

VB

Velocity is measured via a Linear Position Transducer (LPT). Most common are:

- GymAware (2000 USD)
- FLEX (499 USD)
- Tendo (1300 USD)
- Open Barbell/RepOne (399 USD)

The main metric measured with a LPT is Average Concentric Velocity (ACV).

Helms et al., found a very strong inverse relationship between ACV and %1RM in the back squat (-.91), bench press (-.90) and deadlift (-.92). Very strong relationships were also found in my research on the FS and HHBD.

Velocity Based Loading

Dr. Harry Dorrell was the first to use the term velocity-based loading (VBL) vs VBT.

VBT originated with the goal of a training session was to move the bar as fast as possible.

VBL differs as we use ACV in a set where the goal is strength or hypertrophy to dictate the load on the bar, or the number of sets performed.

While high velocity VBT sessions still have utility in most strength and conditioning programs, this presentation aims to focus more on VBL and RPE as it pertains to dictating load at lower velocities.

Longitudinal Research

VBL vs %1RM over a 6-week training program (Dorrell, Smith and Gee, 2020)

- Significant increases in countermovement jump (CMJ) and bench press for the velocity group over %1RM
- These increases, alongside equal increases in both groups in the back squat and overhead press, were accompanied by a significant decrease in total volume performed by velocity group
- Less total volume = increases in strength and CMJ

Longitudinal Research

Dorrell, Smith and Gee also evaluated the effectiveness of an Individualized Load Velocity Profile (ILVP) vs a Group Load Velocity Profile (GLVP, 2020) over a 6-week training study

- No significant differences in strength or power between groups
- Only a greater potential magnitude of change in favor of the ILVP group
- Good for coaches with large groups
- LVPs are reliable on a session-to-session basis (Banyard, Nosaka & Haff, 2017)
- Stays the same after gaining strength (González-Badillo, J. J., & Sánchez-Medina, 2010)

Longitudinal Research

Helms, Brynes and Cook compared RPE based loading vs %1RM loading over 8-weeks (2018)

- Both were effective at increasing strength, with a slight advantage going to the RPE group
- Also supported by Grahm and Cleather who showed that RPE based load prescription increased squat strength more than %1RM (2019)

Velocity vs RPE

- Shattock and Tee compared velocity-based autoregulation vs RPE and found meaningful increases in strength for both groups - with the velocity groups change in strength nearly doubled the RPE group

Meta-Analysis (Hickmott, Chilibeck & Shaw, 2022)

- Autoregulated vs. standard load prescription
- Did not show a significant difference in groups
- Similar results for subjective (RPE) vs objective (Velocity)
- <25% velocity loss vs >25% velocity loss
- Greater velocity loss = more hypertrophy
- Less velocity loss = more strength
- Does not individualize the program, but decreases the variability and ensures an athlete experiences the intended training goal for that day

Misapplication of VBT

- Using the general velocity zones could cause a lifter to under or overshoot their desired training load for that day
- Velocity loss should be used with caution
 - Ex: 40% velocity loss would have the athlete stop their set when the ACV reached 40% below their 1st rep velocity. (First rep is 0.75m/s – set would stop when <0.45m/s is hit)
 - In the front squat, this would leave a lifter with about 1 RIR
 - If this was applied to bench press, first rep ACV could be 0.55m/s, meaning the set would be stopped when ACV was <0.33m/s (5-6 RIR)
 - Additionally, each exercise has its own RPE/ACV profile.

My Research

Table 2

Descriptive characteristics of male and female subjects.*†

Sex	Age (y)	Body mass (kg)	Height (m)	FS 1RM (kg)	HHBD 1RM (kg)	Relative FS 1RM (kg·kg ⁻¹)	Relative HHBD 1RM (kg·kg ⁻¹)
Males (<i>n</i> = 14)	28.9 ± 5.7	89.9 ± 11.9	1.74 ± 0.1	160.2 ± 24.3	267.1 ± 38.0	1.78 ± 0.2	3.0 ± 0.3
Females (<i>n</i> = 13)	30.1 ± 5.4	64.2 ± 9.0	1.60 ± 0.1	102.9 ± 14.8	159.2 ± 22.3	1.6 ± 0.2	2.5 ± 0.3
Combined (<i>n</i> = 27)	29.5 ± 5.6	77.1 ± 10.5	1.70 ± 0.1	131.6 ± 19.6	213.2 ± 30.2	1.69 ± 0.2	2.75 ± 0.3

*FS = front squat; HHBD = high-handle hexagonal bar deadlift; 1RM = 1 repetition maximum.

†Values are mean ± SD.

Day 1	Day 2 – 48hrs later	Day 3 – 48hrs after Day 2
1RM in FS & HHBD	4 sets to failure @ 80% 1RM in FS/HHBD - RPE 6 and 9 Callouts	4 sets to failure @ 80% 1RM in FS/HHBD (movement not done on day 2) -RPE 6 and 9 Callouts

My Research

Table 6

Rating of perceived exertion/ACV profiling.*†

RPE	Front squat, ACV ($\text{m}\cdot\text{s}^{-1}$)			High-handle hexagonal bar deadlift, ACV ($\text{m}\cdot\text{s}^{-1}$)		
	Males	Females	Combined	Males	Females	Combined
7	0.51 $\pm$ 0.05‡	0.43 $\pm$ 0.06	0.47 $\pm$ 0.07	0.33 $\pm$ 0.04	0.34 $\pm$ 0.06	0.33 $\pm$ 0.05
8	0.50 $\pm$ 0.06‡	0.42 $\pm$ 0.06	0.46 $\pm$ 0.07	0.32 $\pm$ 0.05	0.33 $\pm$ 0.05	0.32 $\pm$ 0.05
9	0.46 $\pm$ 0.06‡	0.38 $\pm$ 0.06	0.42 $\pm$ 0.07	0.29 $\pm$ 0.05	0.32 $\pm$ 0.05	0.30 $\pm$ 0.05
10	0.40 $\pm$ 0.06‡	0.34 $\pm$ 0.06	0.37 $\pm$ 0.07	0.24 $\pm$ 0.06	0.29 $\pm$ 0.05‡	0.27 $\pm$ 0.06
1RM	0.29 $\pm$ 0.05	0.27 $\pm$ 0.05	0.28 $\pm$ 0.05	0.18 $\pm$ 0.03	0.20 $\pm$ 0.05	0.19 $\pm$ 0.05
R-value	-0.97	-0.99	-0.98	-0.96	-0.97	-1.00

*ACV = average concentric velocity ($\text{m}\cdot\text{s}^{-1}$); RPE = rating of perceived exertion; 1RM = 1 repetition maximum.

†Values are mean $\pm$ SD. Combined = weighted average of males and females.

‡Significantly faster ACV compared with the opposite sex within the same exercise, $p < 0.05$.

Resources

[Link to my video on instructions](#)

[Link to web-based application](#)

[Link to paper published on instructions on how to use web-based app](#)

Practical Application

RPE and Velocity Range		Absolute Velocity/RPE Stop	
HHBD 4x3 @RPE 7-9 and/or 0.33-0.3m/s		FS x3 @RPE 8/0.46m/s 2-4 Load Drops 5%	
315x3 @ RPE 8 (0.32m/s)	✓	225x3 @ RPE 8 (0.46m/s)	✓
315x3 @ RPE 9 (0.30 m/s)	✓	215x3 @ RPE 6	✓
300x3 @ RPE 7 (0.33 m/s)	✓	215x3 @ RPE 7	✓
300x3 @RPE 8 (0.32 m/s)	✓	215x3 @ RPE 8 (0.46m/s)	⊘

Banyard HG, Nosaka K, Haff GG. Reliability and validity of the load–velocity relationship to predict the 1RM back squat. *The Journal of Strength & Conditioning Research* 31: 1897-904, 2017.

Dorrell, H. F., Smith, M. F., & Gee, T. I. Comparison of velocity-based and traditional percentage-based loading methods on maximal strength and power adaptations. *The Journal of Strength & Conditioning Research*, 34: 46-53, 2020.

González-Badillo, J. J., & Sánchez-Medina, L. Movement velocity as a measure of loading intensity in resistance training. *International Journal of Sports Medicine*, 31: 347-352, 2010.

Graham T, Cleather DJ. Autoregulation by" repetitions in reserve" leads to greater improvements in strength over a 12-week training program than fixed loading *Journal of strength and conditioning research*, 2019

Helms, E. (2017). Using the Repetitions in Reserve-based Rating of Perceived Exertion Scale to Autoregulate Powerlifting Training (Doctoral dissertation, Auckland University of Technology).

Helms, E. R., Storey, A., Cross, M. R, et al. RPE and velocity relationships for the back squat, bench press, and deadlift in powerlifters. *The Journal of Strength & Conditioning Research*, 31: 292-297, 2017.

Helms, ER, Byrnes, RK, Cooke, DM, et al. RPE vs. percentage 1RM loading in periodized programs matched for sets and repetitions. *Frontiers in Physiology* 9: 247, 2018.

Hickmott, L. M., Chilibeck, P. D., Shaw, K. A., & Butcher, S. J. (2022). The Effect of Load and Volume Autoregulation on Muscular Strength and Hypertrophy: A Systematic Review and Meta-Analysis. *Sports Medicine-Open*, 8(1), 1-35.

Jovanović, M., & Flanagan, E. P. Researched applications of velocity based strength training. *J Aust Strength Cond*, 22: 58-69, 2014.

Mann, J. B., Thyfault, J. P., Ivey, P. A., & Sayers, S. P. (2010). The effect of autoregulatory progressive resistance exercise vs. linear periodization on strength improvement in college athletes. *The Journal of strength & conditioning research*, 24(7), 1718-1723.

Shattock, K., & Tee, J. C. Autoregulation in Resistance Training: A Comparison of Subjective Versus Objective Methods. *Journal of strength and conditioning research*, 2020.

Zourdos, MC, Klemp, A, Dolan, C. Novel resistance training–specific rating of perceived exertion scale measuring repetitions in reserve. *The Journal of Strength & Conditioning Research* 30: 267-275, 2016.