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ORIGINAL INVESTIGATION

Perception of Bar Velocity Loss in Resistance Exercises: Accuracy Across Loads and Velocity Loss Thresholds in the Bench Press

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Purpose: Velocity-based training is used to prescribe and monitor resistance training based on velocity outputs measured with tracking devices. When tracking devices are unavailable or impractical to use, perceived velocity loss (PVL) can be used as a substitute, assuming sufficient accuracy. Here, we investigated the accuracy of PVL equal to 20% and 40% relative to the first repetition in the bench-press exercise. ***Methods:*** Following a familiarization session, 26 resistance-trained men performed 4 sets of the bench-press exercise using 4 different loads based on their individual load–velocity relationships (~40%–90% of 1-repetition maximum [1RM]), completed in a randomized order. Participants verbally reported their PVL at 20% and 40% velocity loss during the sets. PVL accuracy was calculated as the absolute difference between the timing of reporting PVL and the actual repetition number corresponding to 20% and 40% velocity loss measured with a linear encoder. ***Results:*** Linear mixed-effects model analysis revealed 4 main findings. First, across all conditions, the absolute average PVL error was 1 repetition. Second, the PVL accuracy was not significantly different between the PVL thresholds ($\beta = 0.16$, $P = .267$). Third, greater accuracy was observed in loads corresponding to the midportion of the individual load–velocity relationships (~50%–60% 1RM) compared with lighter (<50% 1RM, $\beta = 0.89$, $P < .001$) and heavier loads (>60% 1RM, $0.63 \leq \beta \leq 0.84$, all P values < .001). Fourth, PVL accuracy decreased with consecutive repetitions ($\beta = 0.05$, $P = .017$). ***Conclusions:*** PVL can be implemented as a monitoring and prescription method when velocity-tracking devices are impractical or absent.

Keywords: autoregulation, biomechanics, velocity-based training, monitoring

Velocity-based training (VBT) is a method used to prescribe and monitor resistance-training programs based on repetitions' velocity outputs during different exercises.[1–3] VBT programming allows coaches to adjust training variables such as intensity of load (hereby referred to as "load") and volume to target the desired training stimulus using velocity outputs.[1,3] To illustrate, the nearly perfect linear relationship between load and velocity enables prescription of training loads according to the full spectrum of the individual load–velocity curve rather than as percentages derived from a single reference value such as the 1-repetition maximum (1RM).[3,4] The decline in velocity output observed during resistance exercises provides actionable information on the extent of acute neuromuscular fatigue, which accumulates over consecutive repetitions and sets.[5,6] Moreover, velocity outputs can be used to track and account for the day-to-day variability in performance. This enables optimization of the training process by timely accommodating the load, volume, and rest intervals per exercise in an individualized manner.[6,7]

VBT can be applied by setting ranges of velocities that are associated with the physical qualities one is intended to develop.[3] For example, performing repetitions at 0.4 to 0.6 $m{\cdot}s^{-1}$ and 0.9 to 1 $m{\cdot}s^{-1}$ is suggested for strength and power development, respectively.[8–10] The corresponding loads required for the target training stimulus (and thus velocities) are established or adjusted during a multiset warm-up protocol. This is done by comparing the actual velocity outputs at given submaximal loads with the reference individual load–velocity relationships.[3,8,9] To adjust training volume, VBT involves terminating an ongoing set after a number of repetitions when velocity exceedes an absolute value or, more commonly, if velocity exceeded a given percentage. Accordingly, objective "velocity loss" thresholds have been proposed to adjust the target volume in a given exercise, an overall session, or throughout a block of training with the aim to selectively develop different physical qualities, such as muscular power (<20%), strength (ie, 20%–40%), and hypertrophy (>40%).[11,12]

Tracking devices measuring velocity, such as accelerometry-based measurement units and linear position transducers, are needed to implement VBT.[13] These velocity trackers are widely commercialized, portable, and mostly affordable. However, their use is impractical in large groups sharing the same training environment (eg, machines or lifting platforms), or when trainees are required to move quickly and repeatedly from one exercise to the next. In this regard, Sindiani et al[14] and Lazarus et al[15] have recently studied the use of trainees' perception of changes in velocity (PCV) as a simple and practical alternative to VBT using velocity trackers.

Sindiani et al[14] examined the accuracy of PCV in comparison with actual bar velocity measured with a velocity tracker among 20 resistance-trained subjects. Subjects completed 4 sets of 8 repetitions in the squat and bench press exercises, using loads corresponding to 60% and 70% of 1RM, over 2 sessions. Starting from the second repetition of each set, subjects rated their PCV as a percentage of the first repetition, which was preset to be 100% (ie, the reference point), irrespective if it was the fastest repetition or not. To illustrate, if the third repetition was perceived to be 10% slower than the first repetition, then the person should have rated it as 90%. The average absolute error began at ~5.8 in both exercises and ended at ~13.2 and ~16.7 percentage points in the bench press

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and back squat, respectively. Lazarus et al[15] used a similar design, but had elite athletes with experience in VBT performing 4 sets of 6 repetitions in the barbell back squat exercise which was loaded with individual optimum power loads (ie, ~52% of 1RM) rather than a percentage of 1RM as was done in Sindiani et al.[14] The average magnitude of error was lower (range: ~5 to ~8 percentage points) indicating that the PCV may be a viable alternative.

While the findings of these 2 studies are encouraging and support the use of PCV in VBT sessions, the implemented experimental approach has several shortcomings. First, it is possible that the cognitive demands associated with the verbal reporting of PCV after every repetition may hinder one's ability to perceive velocity loss. Second, while reporting PCV after every repetition allows for more data points to be collected, it is not aligned with the practical use of VBT, in which trainees are required to terminate a set only when velocity exceedes a threshold relative to the first repetition.[1,3,8,9,11] Moreover, the studies of Sindiani et al[14] and Lazarus et al[15] used a limited number of loads. Yet, since velocity changes as a function of the load, there is a need to investigate accuracy of perception of changes (or loss) in bar velocity across the broad spectrum of the individual load–velocity relationship.

Accordingly, the purpose of this study was to investigate if resistance-trained participants performing the bench press exercise to task failure can accurately perceive velocity loss at 20% and 40% relative to the first repetition. Participants completed 4 sets with 4 different loads selected across the spectrum of the individual load–velocity relationship. During the task, actual bar velocity loss (AVL) was measured with a linear encoder. In view of the findings of Sindiani et al[14] and Lazarus et al,[15] we expected high perception accuracy with offsets between perceived velocity loss (PVL) and AVL ranging from 1 to 4 repetitions.

Methods

Subjects

Twenty-six male sport science students volunteered to participate in the study (Table 1). To be included in the study, participants had to (1) be healthy, (2) be between the ages of 18 and 40 years, (3) have at least 2 years of resistance training experience in performing the bench press exercise, (4) be able to lift a 1RM load in the bench press exercise ≥1.2 of their body mass, and (5) have no previous experience with the VBT approach in resistance training. Written informed consent was obtained after the participants received an oral explanation of the purpose and potential risks of the study. All procedures were conducted in accordance with the Declaration of Helsinki and approved by the University of the West of Scotland Ethics Committee.

Table 1 Demographic Data

	Mean (SD); range
Age, y	21.3 (2.5); 18–25
Height, m	1.72 (0.12); 1.58–1.88
Weight, kg	78.6 (9.8); 65.3–91.4
Resistance-training experience, y	6.4 (2.3); 4–10
Estimated 1RM bench press, kg	110.6 (16.5); 75–141
Relative 1RM/body mass	1.41 (0.2); 1.2–1.6

Abbreviation: 1RM, 1-repetition maximum.

Design

A correlation study design was used to investigate the relationship between PVL and AVL in barbell velocity during the bench press exercise. Participants reported to the laboratory for one testing and one experimental session separated by 1 to 3 days. In the first session, participants completed a load–velocity relationships assessment in the bench press exercise and were familiarized with the experimental procedures. In the experimental session, they performed 4 sets of the barbell bench press exercise to task failure (ie, defined as the inability to complete another repetition despite attempting to). The loads lifted across the 4 sets were individually adjusted to ensure equivalence of velocity outputs for every first repetition in each set between the participants. Specifically, the regression equation parameters modeling the linear relationship between load and velocity for each participant's individual relationships were used to compute the loads corresponding to velocities in the first repetition of the 4 sets equal to 0.4, 0.8, 1, and 1.2 $m \cdot s^{-1}$. These velocities were selected as they fall within the recommended range for maximal strength and power development in the bench press exercise and are widely used in applied settings.[16–18]

Methodology

Assessment of Load–Velocity Relationships

In the testing session, the load–velocity relationships in the bench press exercise were assessed for each participant. First, participants performed an 8-minute general warm-up consisting of 5 minutes of arm cranking at a self-selected pace on an arm crank ergometer (Ergoselect 400, ergoline GmbH) and 3 minutes of upper-body dynamic mobilization exercises. Second, 3 barbell bench press (Eleiko) warm-up sets (repetition range: 5–8) with progressively heavier loads (intensity range: 30%–80% of estimated 1RM) were performed. Then, the load–velocity relationships were assessed following the protocol described by Loturco et al,[19,20] consisting of consecutive lifts (range: 4–6 sets of 2–3 repetitions each) with progressively heavier loads (corresponding velocity range: 1.4–0.3 $m \cdot s^{-1}$). Participants were instructed to remove the barbell from the rack support gripping it with both hands so that the elbows formed an angle of approximately 90° with the bar, and the hands were in line with the elbows. Then, during the eccentric phase, the barbell was lowered to the chest with a controlled tempo of approximately 2 seconds. After a pause of approximately 1 second, the barbell was returned to the starting position as fast as possible during the concentric phase. Barbell velocity was recorded during the concentric phase of each repetition of the progressively heavier sets using a linear encoder (Chronojump). The greatest mean propulsive velocity values were then used to model the load–velocity relationships[19] and then calculate the individual loads used in the experimental session.

Following the load–velocity relationships assessment, participants were familiarized with the procedures of the experimental session by performing 2 sets to task failure using a barbell loaded with self-selected loads. Specifically, during the ongoing set, participants were asked to verbally report the repetitions corresponding to their 20% and 40% PVL relative to the first repetition. Neither verbal nor visual feedback on the accuracy levels observed during the familiarization session was provided to the participants to avoid any learning effects.

Experimental Session

Following the same standard and specific bench press warm-up protocols of the testing session, participants completed 4 sets to task failure of the bench press exercise, using loads corresponding to the 4 target velocities reported above. The order in which the sets were completed was randomized (www.random.org). Rest intervals of 3 minutes were provided between consecutive sets. The experimental session was performed with the same equipment and procedures described for the load–velocity relationships assessments and familiarization session, and conducted by the same 2 researchers at approximately the same time of the day (4–6 PM). During the experimental conditions, if the actual velocity (ie, live monitored with the linear encoder) of the first repetition deviated from the target anchor velocity (eg, 0.4, 0.8, 1, and 1.2 $m{\cdot}s^{-1}$), participants were instructed to terminate the ongoing set immediately. Researchers then promplty recalculated and adjusted the load to accommodate the target velocity before the set could be resumed.[3,9] Participants were asked to refrain from intense training targeting muscle groups involved in the bench press exercise for at least 48 hours prior to the experimental session, to avoid confounding effects due to muscular fatigue and soreness.

Bar Velocity Data Processing

The mean propulsive velocity outputs were collected using a linear encoder sampling at 1000 Hz, which was fixed to the barbell at a perpendicular angle to the floor during the bench press exercise. According to the software specifications, instantaneous velocity was smoothed with a fourth-order low-pass Butterworth filter with a cutoff frequency of 10 Hz, which was computed using the commercial software provided by the manufacturer in conjunction with the device.[21] Data were then exported into a Microsoft Excel spreadsheet to (1) calculate AVL (%) values in each set from the second repetition onward in relation to the first one, (2) determine the repetition numbers (no.) corresponding to the 20% and 40% AVL values, and (3) count the number of repetitions (no.) that each participant performed until 20% and 40% AVL occurred. The full dataset is available in Supplementary Material 1 (available online).

Statistical Analysis

Descriptive data are presented as mean (SD) unless otherwise stated. Replicating the statistical analysis approach described in the studies of Sindiani et al[14] and Lazarus et al,[15] we first calculated the raw differences between the PVL and AVL and then transformed all differences into absolute values (ie, ignoring direction of error). This allowed to report the extent of the average error in terms of number of repetitions while overcoming the offsetting effect of opposing negative and positive errors. To examine the effects of lifting velocities, velocity loss thresholds, and number of repetitions performed until 20% and 40% velocity loss on PVL accuracy, we used the following linear mixed-effects model:

$$|\mathrm{PVL} - \mathrm{AVL}|_{in} = b_{0in} + b_{1-3}\,\mathrm{velocity} + b_4\,\mathrm{percent}_{in} + b_5\,\mathrm{repetition} + \varepsilon_i.$$

For this purpose, raw differences between the PVL and AVL represent repeated measures for subject "in" and served as outcome measures, whereas lifting velocities ("velocity": categorical variable with 4 levels [0.4, 0.8, 1, 1.2]), velocity loss thresholds ("percent": categorical variable with 2 levels [20%, 40%]), and number of repetitions performed until 20% and 40% PVL ("repetition": continuous variable with range 3–34) were modeled as predictor variables and treated as fixed effects. Moreover, random effects were assumed for participants and velocity loss thresholds and random slopes were introduced in the model if their addition did not result in a convergence error. Estimated marginal means and 95% confidence intervals (CIs) were calculated alongside comparisons made using post hoc Holm–Bonferroni adjustments. Visual inspection of residual plots was used to confirm the assumptions of homoscedasticity or normality, which was also assessed through the Shapiro–Wilk test. Moreover, since regression models can be sensitive to multicollinearity, we computed the variance inflation factors for all predictor parameters used in the linear mixed-effects model to inspect the presence of autocorrelation between pairs of predictors. All statistical analyses were conducted in R language and environment for statistical computing using the *lme4*, *lmerTest*, *emmeans*, and *ggeffects* packages while model assumptions were checked using the *performance* package (version 4.0.5). The full data analysis code is available in Supplementary Material 2 (available online).

Results

For descriptive purposes, outputs of the experimental session are presented as means, SDs, and range intervals in Table 2, whereas the frequency distribution of the absolute PVL errors (ie, |PVL − AVL|) and the raw individual data points grouped by PVL thresholds across the velocity conditions are depicted in Figures 1 and 2, respectively. Results from the linear mixed-effects model are presented in Table 3.

The absolute PVL error was, on average, 1 repetition (95% CI, 0.95 to 1.06) across all PVL thresholds and velocity conditions. In 24% of the cases, participants accurately perceived the exact repetition corresponding to the anchor PVL thresholds (ie, |PVL − AVL| = 0). In 54% of the cases, participants had an error of 1 repetition (ie, |PVL − AVL| = 1), and in the remaining 22% of the cases, participants had an error equal or greater than 2 repetitions (ie, |PVL − AVL| ≥ 2) (Figure 1). When controlling for lifting velocities, repetitions, and participants, the absolute PVL error was not significantly different between the 20% and 40% PVL thresholds ($P = .267$, $b = 0.16$ [95% CI, –0.12 to 0.45] repetitions). The absolute PVL error was significantly lower in the 1 $m{\cdot}s^{-1}$ lifting velocity condition compared with all other lifting velocities ($P < .001$, $0.63 \le b \le 0.89$). Finally, the absolute PVL error increased significantly with every successive repetition ($P = .017$, $b = 0.05$ [95% CI, 0.008 to 0.08] repetitions).

Discussion

The purpose of this study was to examine the accuracy of PVL among resistance-trained participants performing the bench press exercise across lifting velocities and velocity loss thresholds. We observed 4 main findings. First, across all lifting velocities, the absolute PVL errors were mostly contained within 2 repetitions. Second, the PVL accuracy was not significantly different between the PVL thresholds. Third, participants were more accurate in the 1 $m{\cdot}s^{-1}$ velocity compared with all other velocities. Fourth, the PVL errors increased with consecutive repetitions. These findings futher support and strengthen PVL as a simple, practical, and cost-effective autoregulation alternative to VBT using velocity trackers.

The magnitude of absolute PVL errors and their similarities across the 2 velocity loss thresholds (ie, 20% and 40%) suggest that the PVL approach is a feasible subjective VBT monitoring method in resistance training.[14,15,22,23] To illustrate, the average absolute error was 1 repetition across all conditions, which means that the participants' PVL accuracy deviated only slightly from the objective VBT targets. However, coaches are nevertheless required to decide whether the observed PVL error rates are acceptable in view

Table 2 Experimental-Session Data

	Mean (SD); range
Intensity	
Percentage of 1RM for 0.4 m·s^{-1}, %	85.2 (2.5); 79–88
Percentage of 1RM for 0.8 m·s^{-1}, %	63.8 (2.3); 59–68
Percentage of 1RM for 1 m·s^{-1}, %	54.8 (3.2); 48–60
Percentage of 1RM for 1.2 m·s^{-1}, %	45.8 (2.7); 39–50
Volume	
Reps at 20% PVL for 0.4 m·s^{-1}, no.	4.7 (1); 3–6
Reps at 20% PVL for 0.8 m·s^{-1}, no.	6.6 (1.6); 4–11
Reps at 20% PVL for 1 m·s^{-1}, no.	12.4 (1.5); 9–15
Reps at 20% PVL for 1.2 m·s^{-1}, no.	15.8 (3.3); 8–28
Reps at 40% PVL for 0.4 m·s^{-1}, no.	8.4 (1.4); 6–11
Reps at 40% PVL for 0.8 m·s^{-1}, no.	12.3 (2); 9–18
Reps at 40% PVL for 1 m·s^{-1}, no.	19.5 (1.7); 16–23
Reps at 40% PVL for 1.2 m·s^{-1}, no.	23.7 (3.5); 19–34
Velocity outputs (mean difference across all reps)	
|PVL – AVL| at 20% PDL for 0.4 m·s^{-1}, %	6.8 (3.2); 0.2–12.4
|PVL – AVL| at 20% PDL for 0.8 m·s^{-1}, %	10.2 (3.8); 4.3–17.2
|PVL – AVL| at 20% PDL for 1 m·s^{-1}, %	7.8 (2.9); 1.4–15.4
|PVL – AVL| at 20% PDL for 1.2 m·s^{-1}, %	9.5 (4.3); 4.5–14.3
|PVL – AVL| at 40% PDL for 0.4 m·s^{-1}, %	9.6 (4.3); 1.3–19.6
|PVL – AVL| at 40% PDL for 0.8 m·s^{-1}, %	16.4 (4.1); 3.1–23.4
|PVL – AVL| at 40% PDL for 1 m·s^{-1}, %	9.3 (4.8); 0.1–15.8
|PVL – AVL| at 40% PDL for 1.2 m·s^{-1}, %	19.6 (5.2); 1.3–32.3
PDL accuracy	
|PVL – AVL| at 20% PDL for 0.4 m·s^{-1}, no. of reps	0.8 (0.5); 0–2
|PVL – AVL| at 20% PDL for 0.8 m·s^{-1}, no. of reps	0.8 (0.6); 0–2
|PVL – AVL| at 20% PDL for 1 m·s^{-1}, no. of reps	0.3 (0.5); 0–1
|PVL – AVL| at 20% PDL for 1.2 m·s^{-1}, no. of reps	1.2 (0.5); 0–2
|PVL – AVL| at 40% PDL for 0.4 m·s^{-1}, no. of reps	1.1 (0.6); 0–2
|PVL – AVL| at 40% PDL for 0.8 m·s^{-1}, no. of reps	1 (0.6); 0–2
|PVL – AVL| at 40% PDL for 1 m·s^{-1}, no. of reps	0.8 (0.6); 0–2
|PVL – AVL| at 40% PDL for 1.2 m·s^{-1}, no. of reps	2.1 (0.7); 0–4

Abbreviations: AVL, actual velocity loss; PVL, perceived velocity loss; reps, repetitions; 1RM, 1-repetition maximum.

of their overall resistance training goals. For example, while a PVL error equal to 1 repetition is likely negligible in sets consisting of 8 repetitions or more, yet such an error may be meaningful in sets consisting of 6 repetitions or less. We note that it is possible to reduce the magnitude of the PVL errors through augmented feedback sessions as successfully demonstrated in previous studies of Lazarus et al[15] and Romagnoli and Piacentini.[24] In case that consistent unidirectional PVL error patterns emerge, it may be possible to use a correction factor to overcome the systematic bias and level off under- or overestimating outcomes.

When interpreting the differences in PVL accuracy between lifting velocities, we are uncertain why participants were significantly more accurate in the 1 m·s^{-1} velocity compared with all other velocities when controlling for PVL thresholds, repetitions, and participants. The absence of a clear pattern across velocities of the force–velocity relationships seems to exclude any associations between mechanical underpinnings and PVL accuracy. Therefore, until future studies will further investigate the relationships between lifting velocity and PVL accuracy, we consider this finding to be spurious. Despite the significant differences in PVL accuracy between velocities being unclear, the linear regression model coefficients in Table 3 highlight that higher PVL accuracy levels are expected when performing sets with loads corresponding to the mid-portion of the load–velocity relationship (ie, 50%–60% 1RM; Table 2). Practically, this finding seems to encourage the use of PVL as a subjective VBT autoregulation method especially when the resistance training goal is to develop and maintain muscular power.[3,4,11,12,15,18,19,25–27]

Aligned with Sindiani et al[14] and Lazarus et al,[15] we also observed that the PVL error increased with consecutive repetitions, even when controlling for lifting velocity, PVL thresholds, and participants. As previously proposed, we presume that the reasons for this effect can stem from 2 main pathways that may also interact. The first is the time elapse between the first repetition (ie, the reference point) and the corresponding PVL thresholds. This time delay likely hinders PVL accuracy as trainees forget what the velocity of the first repetition felt like, making it difficult for them to estimate velocity loss.[14] We note that this time delay

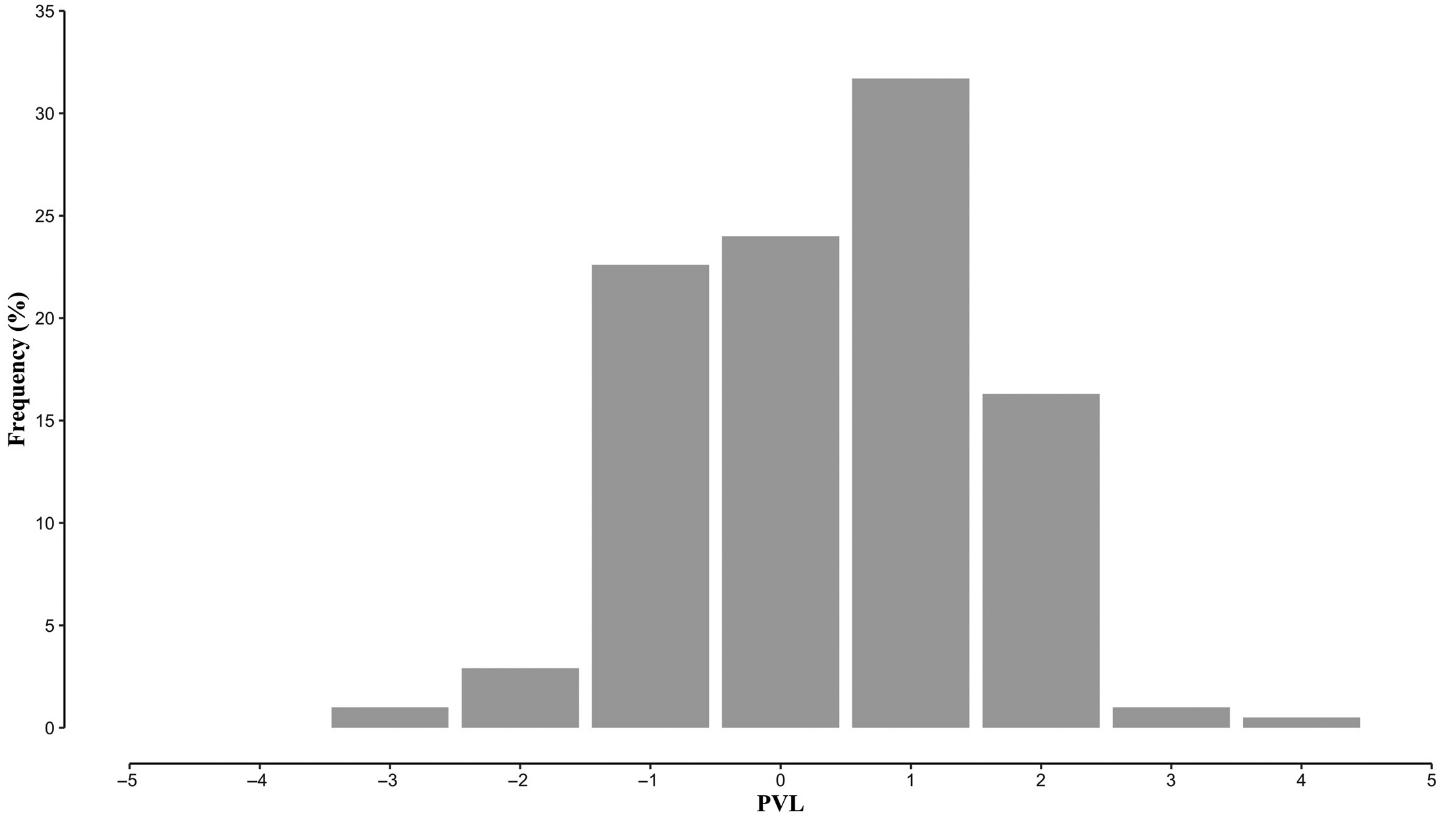

Figure 1 — Distribution of the PVL estimations. PVL indicates perceived velocity loss.

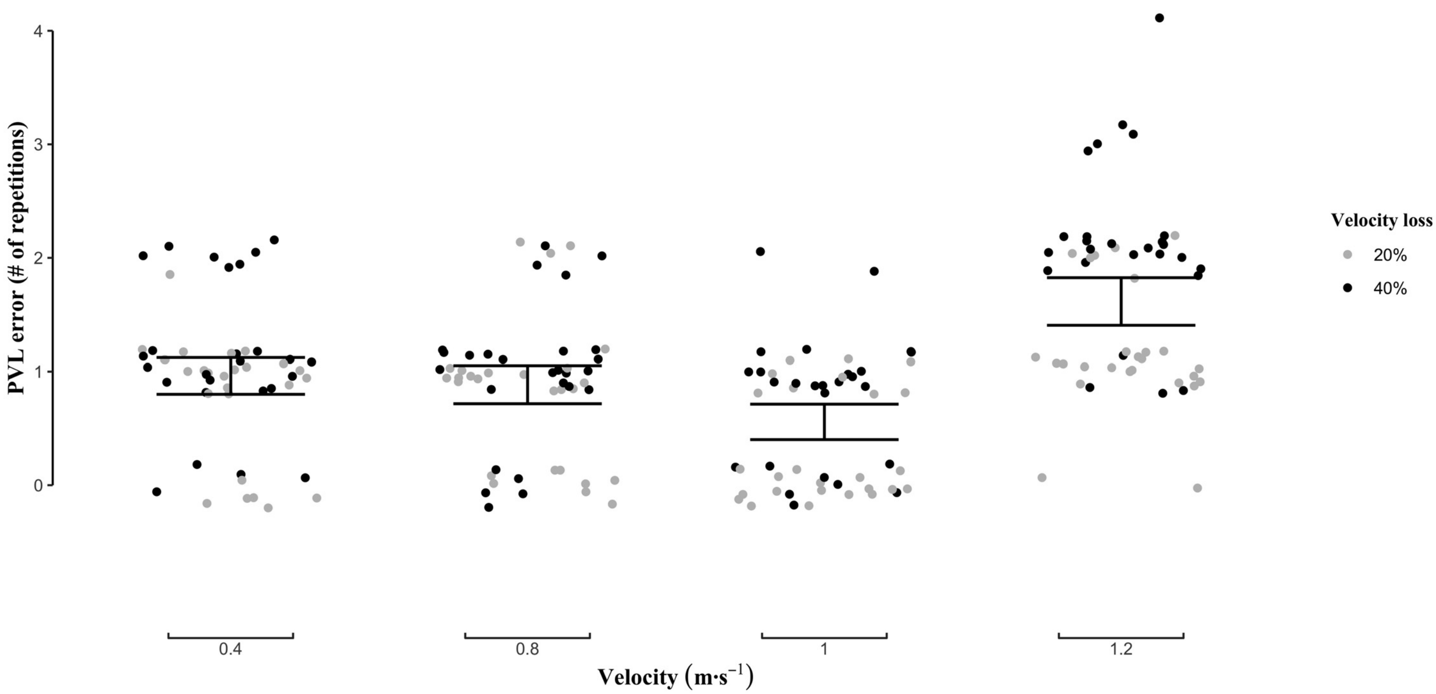

Figure 2 — PVL estimations across velocities and velocity loss thresholds. PVL indicates perceived velocity loss.

Table 3 Linear Regression Fixed-Effects (Within-Subject) Outputs of the Extent of Error in Perceived Velocity Loss

	Coefficient	SE
Constant	−0.26	0.27
[1 m·s^{-1}]		
0.4 m·s^{-1}	0.84***	0.21
0.8 m·s^{-1}	0.63***	0.17
1.2 m·s^{-1}	0.89***	0.13
[20%]		
40%	0.16	0.15
Repetitions	0.05*	0.02
N (within 26 subjects)	208	

*$P < .05$. ***$P < .001$.

increases as a factor of each subsequent repetition but also due to the velocity loss associated with the slower execution of repetitions performed later in a set due to fatigue. The second is neuromuscular fatigue and perceptual responses occurring during the ongoing set. For example, metabolic byproducts may accumulate in the working muscles with subsequent increases in perception of discomfort[28] hindering participants' ability of estimating PVL.

When considering the full range of repetitions that participants performed across all velocity and PVL thresholds conditions (3–34), we note that the loss of accuracy due to any additional repetition is approximately −0.05 (Table 3). While this finding was statistically significant, it seems practically nonmeaningful. This is because the average effect of repetitions on PVL accuracy would be as small as 0.10 and as large as 1.65 repetitions when applied to the extreme ends of the repetitions performed. While a PVL error of 1.65 repetitions performed can be viewed as too large, this worst-case scenario reflects only training sessions with sets including more than 30 repetitions. Given that most of the resistance training protocols consist of sets including between 4 and 15 repetitions,[17] the expected PVL error would range between 0.15 and 0.7 repetitions per set, which seems acceptable. Future studies are required to directly examine the relationships between PVL accuracy and number of repetitions performed in consecutive sets across a broader range of exercises.

This study has a few limitations worthy of discussion. First, our study only included young male participants without experience in VBT, who performed a single exercise. It is thus unclear if our findings generalize to other populations and exercises. Second, the experimental trials did not reflect typical resistance training sessions, as trainees were required to reach failure at each set and use a range of loads. Third, we only examined PVL accuracy of 2 time points. It may well be the case that accuracy may improve or worsen at lower velocity loss points, such as 5% to 10%, which are more closely associated with improvements in power-related outcomes. Finally, neither metabolic (ie, lactate) nor other perceptual responses (eg, fatigue, pain, discomfort, affective valance) were collected during the experimental sessions. Therefore, the underpinning mechanisms and the extent to which they may affect PVL accuracy could not be fully explored.

Practical Applications

The use of PVL in resistance training practice depends on the load selected for the training session, the velocity loss threshold for set termination, the precision one is after, and the number of repetitions expected to be completed per set. For example, PVL may be used in sessions with loads ranging between 50% and 90% 1RM, velocity loss thresholds of 20% or 40%, number of repetitions per set between 4 and 15, and willingness to accept an PVL error equal to 1 repetition. In contrast, for sessions including lighter loads (ie, <40% 1RM) and higher expected repetitions per set (eg, >15), with a target error rate of less than 2 repetitions, this strategy would seem unacceptable. In such training sessions, velocity measuring devices would still have to be used.

Conclusions

This is the first study investigating the accuracy of PVL across different loads and velocity loss thresholds in the bench-press exercise. We observed what seems to be acceptable accuracy across all conditions, as the errors mostly revolved around 1 to 2 repetitions from the velocity loss thresholds. The absolute error was smaller for loads corresponding to the midportion of the individual load–velocity relationships (~50%–60% of 1RM), with similar accuracy between the 2 velocity loss thresholds. The errors somewhat increased in sets composed of more repetitions across loads. More research is required to establish whether this perception-based approach is applicable in velocity-based training programs designed for different training targets and when implementing different exercises.

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