**Background**

Resistance training safely improves a range of outcomes in older adults, with high-velocity resistance training (HVRT) the most effective at improving power and function in this group. Improving power generation with training such as HVRT is critical for older adults because muscle power is more important than muscle strength for physical function, dynamic balance and reacting to a loss of balance to prevent a fall.

While HVRT is effective, the benefit of such training is partly dependent on maximising movement velocity. Providing augmented feedback during resistance training is effective at improving movement velocity, motivation, and functional performance in young adults,1 but the use of feedback during resistance training in older adults has not been studied. Feedback is an integral component of a physiotherapist’s tool kit to optimise interventions (e.g., providing verbal feedback during task practice) but evidence to support the efficacy of feedback during HVRT in older adults does not yet exist.

The proposed study will be the first to identify whether providing augmented feedback during resistance training enhances movement velocity in older adults. Based on the established benefits of adding targeted instruction or feedback to other physiotherapy interventions,2 and the identified benefits of velocity-based feedback in young adults, it is hypothesised that augmented feedback will improve movement velocity during training. Improved movement velocity should translate to greater power adaptations and functional improvements.1 If feedback is effective at improving within session performance in older adults, the benefits may be transferrable to other physiotherapy settings such as rehabilitation where improving muscle power and function is a priority for most patients. Importantly, if feedback influences perceived exertion/motivation, this has positive implications for exercise adherence.

The objectives of this study are to identify whether:

* 1. providing augmented feedback during a resistance training session increases barbell velocity in older adults
	2. different types of augmented feedback (e.g., visual) optimise barbell velocity
	3. provision of feedback influences motivation and perceived exertion in older adults

If augmented feedback is effective at improving within session performance in older adults, the benefits may be transferrable to other physiotherapy settings such as rehabilitation where improving muscle power and function over time is a priority for most patients (e.g., post stroke). Importantly, if feedback influences perceived exertion or motivation, this may have positive implications for exercise adherence.

**Methods**

The study will be registered with ANZCTR, adhere to the CONSORT statement, TIDieR checklist and CERT template.3

Study design: within-participant, repeated measures experimental study

*Recruitment*

Sixteen older adults will be recruited from local fitness facilities and through advertising via local community organisations (eg. Probus, Rotary) and [stepupforageingresearch.org.au](http://www.stepupforageingresearch.org.au).

*Inclusion criteria*

Aged 65-85 years with at least 12 months of resistance training experience and able to attend five sessions at ACU Brisbane.

*Exclusion criteria:*

Orthopaedic surgery in the past 6-months, uncontrolled cardiovascular disease, cognitive impairment, progressive neurological condition, severe visual or hearing impairment that would limit ability to receive feedback.

*Sample size*

An a priori power analysis was conducted (G\*Power) to estimate sample size based on a similar study with an effect size in of 1.11.4 Consequently, to identify a moderate effect, the minimum sample size of 12 is required for a repeated measures ANOVA (with α = .05 and power = .80). We plan to recruit 16 participants to ensure adequate power.

*Study procedures*

Participants will attend an initial baseline testing session and four subsequent sessions. Each session will last approximately one hour. All sessions will be separated by at least four days.

Session 1

1. Baseline demographic (age, gender, education) and anthropometric (height, weight, BMI) information will be collected.
2. Three repetition maximum (3RM) strength will be assessed on the leg press then the bench-press following standard protocols.5 All participants should attain their 3RM within five trials. The 3RM weight will then be used to prescribe the training weight (60% of 3RM) for session 2-5 (intervention). The incidence of injury or adverse events associated with strength testing (including 1RM and 3RM) is very low for older adults.6 7
3. Functional outcomes – maximal walking speed and five times sit to stand
4. Demonstration of, and familiarization with the four feedback modes (verbal feedback relating to movement velocity, visual feedback relating to movement velocity, verbal encouragement, and control/no feedback).

Session 2-5

Participants will perform three sets of 10 repetitions at 60% 3RM on each exercise following a standardized warm-up under one of the four conditions at each session (each session separated by at least four days). This load/dosage should allow all participants to successfully complete all sets8 and was intentionally set 15% lower than previously used in young adults9 to reduce the likelihood of momentary muscular failure (unable to complete the target set) in this older cohort. All four conditions will be completed in a randomized crossover order determined through computer-generated random numbering. For all conditions, participants will be instructed to be as “forceful and powerful” as possible during the concentric phase of each repetition. Concentric velocity will be measured for each repetition using a linear position transducer (GymAware). This system will be connected to an iPad that will display the mean concentric velocity for each repetition in real time. Participants will be “spotted” by a researcher at all times.

*Augmented feedback conditions assessed during session 2-5*

a. Control condition – prior to each set, participants will be instructed to be as “forceful and powerful” as possible during the concentric phase of each repetition. No further instruction or feedback will be applied.

b. Verbal kinematic feedback – in addition to the standard control instruction (i.e.” “…forceful and powerful”), a researcher will verbally state the mean concentric barbell velocity that was recorded on an iPad (see above) for each repetition at a volume slightly greater than conversation volume.

c. Visual kinematic feedback - in addition to the standard control instruction, the participant will see a display of mean concentric velocity (m per second) directly in front of them (or above them for bench press). The display will be in large font, on an iPad that will be placed approximately 1 m away.

d. Verbal encouragement - in addition to the standard control instruction, a researcher will stand perpendicular to the subject and provide standardized verbally encouragingly statements during repetitions 2–9 (i.e., repetition 2: “Way to go!”; repetition 3: “Come on!”; repetition 4: “Good job!”; repetition 5: “Excellent!”; repetition 6: “Come on, push it!”; repetition 7: “Keep it up!”; repetition 8: “Push it!”; and repetition 9: “Let’s go!”). These phrases were chosen because they have previously been shown to improve physical performance. All verbal encouragement was at a volume slightly louder than normal conversation volume.

***Primary outcome***

Mean and peak concentric velocity will be measured for each repetition during session two to five using a linear position transducer (GymAware) to identify differences between control and feedback conditions. The GymAware device is valid and reliable10 for measuring velocity and has been used previously to facilitate augmented feedback.9

***Secondary outcomes***

While concentric velocity is the primary outcome of interest, each secondary outcome will help to identify whether different forms of feedback influence factors that may be important for exercise adherence in older adults.11

a.Perceived exertion – participants will rate their perceived exertion at the end of each set (Omni-res 0-10 scale) to identify whether different forms of feedback influence perceived exertion within session.

b. Motivation - the motivation subscale from the Dundee Stress State Questionnaire will be used to assess motivation at the end of each training session.

c. Five time sit to stand (5xSTS) – assessed at baseline and at the end of each session to assess acute training effects on power/function.

d. Maximal gait speed - assessed using the timed 10m walk test at baseline and at the end of each training session (ie. session 2-5) to assess acute training effects on power/function.

e. Fatigue - participants will report their levels of fatigue (0-10 scale) 24 hours after each training session (via email/phone response).

Additionally, incidences of adverse events (AE) ranging from residual muscle soreness to muscle strain/joint pain will be monitored and reported.

*Statistical analysis*

The mean difference in concentric velocity between control and each feedback type will be calculated. To ascertain statistically significant differences between feedback types, repeated measures analysis of variance (ANOVA) will be applied.

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