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Effect of Practice on Performance and Pacing Strategies During an Exercise Circuit Involving Load Carriage

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Abstract

Pacing is critical for athletic endeavors, and the strategies used by athletes are often modified after practice. The importance of practice when completing occupational assessments has been established; however, the effect of load carriage and discrete subtask activities on strategies to modulate physical exertion to complete a work task simulation is currently unknown. Therefore, we sought to investigate the effect of practice on pacing strategies used to complete a physiological aptitude assessment circuit. Twenty-five participants completed an assessment designed for firefighters on 3 occasions. The circuit comprised 6 disparate tasks (including unilateral load carriage, static holds and fire-hose drags) with lap and task completion times recorded. Pacing strategies were examined relative to the effect of practice throughout (globally) and within the assessment (discrete tasks). By the second visit, overall test performance and discrete task performance of the first, fourth, and fifth tasks improved, respectively, by 12.6% (95% confidence interval: ±3.6%, $p < 0.01$), 12.4% (±6.0%, $p < 0.01$), 11.7% (±4.9%, $p < 0.01$), and 17.8% (±10.0%, $p < 0.03$). Compared with visit 1, significant improvements in performance were observed on the second and third visit. However, no significant additional improvement was noted between visits 2 and 3. Therefore, to reliably assess performance of the occupational test, 1 practice session (2 visits) is required. Practice is important to allow individuals to optimize their pacing strategy for successful performance.

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Title: The effect of practice on performance and pacing strategies during an exercise circuit involving load-carriage

Running head: Pacing during a loaded exercise-circuit

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ABSTRACT

Pacing is critical for athletic endeavours, and the strategies used by athletes are often modified following practice. The importance of practice when completing occupational assessments has been established, however the effect of load carriage and discrete sub-task activities on strategies to modulate physical exertion to complete a work task simulation is currently unknown. Therefore, we sought to investigate the effect of practice on pacing strategies employed to complete a physiological aptitude assessment circuit. Twenty-five participants completed an assessment designed for firefighters on three occasions. The circuit comprised six disparate tasks (including unilateral load-carriage, static holds and fire-hose drags) with lap and task completion times recorded. Pacing strategies were examined relative to the effect of practice throughout (globally) and within the assessment (discrete tasks). By the second visit, overall test performance and discrete task performance of the first, fourth and fifth tasks improved respectively by 12.6% (95% CI: ±3.6%, P<0.01), 12.4% (±6.0%, (*P*<0.01), 11.7% (±4.9%, *P*<0.01) and 17.8% (±10.0%, *P*<0.03). Compared to visit one, significant improvements in performance were observed on the second and third visit. However, no significant additional improvement was noted between visit two and three. Therefore, to reliably assess performance of the occupational test, one practice session (two visits) are required. Practice is important to allow individuals to optimise their pacing strategy for successful performance.

Keywords: occupational fitness, physical employment, familiarisation, employment standard

INTRODUCTION

Military, emergency and public safety employees often encounter physically demanding tasks including load carriage during their occupational duties (18, 33, 41). So considerable are the demands that legally defensible, but nonetheless discriminatory high-stakes physiological aptitude tests have been adopted as a mandatory requirement of employment (14, 19). These assessments are considered high-stakes since they represent a barrier to employment. Therefore, it is important to ensure that the assessment is reliable by eliminating factors that may increase false-negatives. Such factors include biological (such as sleep, nutrition and hydration status), environmental (test conditions), and technical variability (test set-up and equipment calibration) and an individuals' familiarity with the test. Once technical, environmental and learning effects are controlled for, any difference in an individual's performance will be due to biological factors and the test would therefore be deemed reliable (9, 28).

Practice of, or familiarisation with, physiological aptitude assessments reduces learning effects and minimises false-negatives (9, 18). Part of the improvement observed following practice may be the establishment or modification of an optimal global pacing strategy in order to complete work faster or more efficiently (25, 27). Pacing is often a pre-planned behaviour undertaken to manage the distribution and intensity of effort (12), and is critical for the completion of complex activities (3, 44). Given physiological aptitude tests are often characterised by disparate and technically difficult tasks (15, 16, 19), these findings suggest that practice is essential to modify pacing strategies in order to optimise performance (9). Therefore, a synergy exists between practice and pacing strategy (25, 27). Practice allows participants to acquire knowledge and gain an understanding of the physical demands associated with performance of the task, helping the individual to develop and modify an exertional 'template' or strategy (45).

Yet, while some investigations have determined the effect of practice on pacing and performance in a physical aptitude test (9, 18), no investigation to the authors knowledge has examined between- or within-task pacing strategy of a physiological aptitude assessment. Furthermore, it is common within physically demanding occupations for critical tasks to be performed while carrying additional external load or wearing heavy personal protective equipment (16, 18); conditions that are known to significantly increase physiological strain (20, 31, 43). Consequently, the increased physiological burden associated with load carriage may also influence preferred pacing strategies for the completion of work tasks. Given that physiological aptitude assessments are often characterised by a series of discrete sub-tasks (9, 16, 19, 24, 37), we determined if distinct pacing strategies were utilised by novice participants within each loaded or unloaded sub-task of the assessment. To our knowledge, this relationship has not previously been explored.

METHODS

Experimental approach

This investigation utilised a repeated-measures design where subjects completed the assessment on three occasions. A convenience sample of University students was used given that the physiological aptitude test is designed for applicants and not skilled incumbents. Since participants were a sample of convenience, participants were not specifically training in anticipation of a physical aptitude assessment as potential applicants would be. However all were physically active (completing muscular strength and/or cardiorespiratory training) and young, and therefore broadly representative of firefighter applicants. In addition, this sample was deemed appropriate given that during the development of the assessment there was no difference in performance between a skilled and unskilled population (14).

Subjects

Thirty-five healthy and physically-active University students (17 males, 18 females; age: 21.6 y (SD 4.7, range: 18-41 y), height: 1.74 m (SD 0.8), mass: 72.0 kg (SD 10.5)) volunteered. Prior to participation, individuals were informed of the risks and benefits of participation, completed a health-screening questionnaire and signed an institutionally approved informed consent document. All procedures were approved by the University Human Research Ethics Committee.

Procedures

Participants completed the firefighter barrier assessment on three separate occasions inside a 10-day period with ≥24 hours separating each visit. The validated assessment examined in this investigation is described in detail and illustrated elsewhere (16) and was conducted as per the protocol used by Fire and Rescue NSW. Briefly, the test was performed while wearing personal protective clothing and equipment (equalling 22.3 kg). The carriage of load to simulate that during occupational tasks is an important part of any physiological aptitude assessment, as outlined by multiple experts (32, 43). The assessment is comprised of six tasks (Table 1), performed in series over a 30 m circuit, where multiple laps of 30 m are completed to achieve the required distance for each task, *e.g.* 6.5 laps for task 1 (total 195 m). During tasks four and five, participants dragged a load 30 m before walking back (30 m) without carrying the load. All tasks were performed at maximal walking pace, running was not permitted since firefighters do not run during their work. Before the test, participants were instructed to: "complete the test as quickly as possible; tasks one to four are performed in series with no prescribed rest; task five commences 15 minutes after the start of the test, thus if tasks 1-4 are completed in <15 minutes, you will rest; to pass, tasks 1-4 must be completed in < 15 min and tasks 5 and 6 must be completed in <2 minutes. At any time, you may rest at your own discretion; however the stopwatch will continue timing your performance". Before the first attempt, each task was demonstrated and participants lifted each load in the required postures.

<Table 1 about here>

A member of the research team accompanied each participant during the assessment to record lap and task completion times and total time to complete the entire assessment. Heart rate (Polar Electro Sports Tester, Kempele, Finland) was continuously recorded and participants provided a rating of perceived exertion (RPE) after each task (8).

Statistical analyses

Pacing was determined globally (whole test) and within dynamic tasks (1, 4, 5 and 6) as average movement speed ($m.s^{-1}$) calculated from lap completion times, similar to published literature (23, 44). Within tasks 4 and 5, pacing during laps with a loaded component additional to the personal protective equipment (e.g. dragging, carrying load) are classified as 'loaded' and are compared with 'unloaded' laps with only the equipment worn. Lap completion times, within tasks, were compared to evaluate the pacing strategy selected by participants, for example a fast-start (first lap significantly faster than all others) or an even-distribution (all laps similar) pacing strategy. Data were assessed using t-tests (paired, two-tailed) and repeated measures analyses of variance (ANOVAs). Where interactions were observed a Tukey's post-hoc test was applied. Multiple measures of reliability have been included (4, 38). Pearson's correlation, regression and intraclass correlation (two-way random effects, single-measure reliability) analyses were performed. The standard error of measurement for visits 1-2 and 2-3 was calculated using the following equation:

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The coefficient of variation was also calculated for visit 1-2 and 2-3 for each subject and then reported as a mean for the entire sample (17). Ideally, tests similar to the one in this investigation (time-trials) should have a coefficient of variation <5% (10). Finally, the 95% limits of agreement was calculated between visits where no systematic bias (i.e. significant different) existed. A Bland-Altman plot was used to graph the mean and residual scores from consecutive visits and a non-significant Pearson's correlation was used to determine data were homoscedastic. From this information, the following calculation was performed:

95% □□□□□□ □□ □□□□□□□□□ = □□□□□□□□ □□□□□□□□□ □□ □h □ □□□□□□□□□□ □□□□□□ × 1.96

A post-hoc analysis, as part of the repeated measures ANOVA of completion time, revealed an achieved power of 0.99. Data are presented as means or change and 95% confidence intervals (CI) unless stated as standard deviation (SD). Significance was set at $P<0.05$.

RESULTS

Thirty-five participants attempted the assessment on the first visit, and twenty-five (15 males, 10 females) were able to complete the entire assessment, *i.e.* all six test components. Ten individuals (2 males, 8 females) did not have sufficient physiological aptitude to complete the assessment (voluntarily terminated the test during the first or second tasks), on either their first or second attempt, and therefore their data were excluded. Of the participants who could complete the assessment (*N*=25), on the first visit five participants did not pass either the 15 min or the 2 min pass-standard for Tasks 1-4 and 5-6 respectively. On the second and third visits all participants (*N*=25) passed.

Assessment reliability

There was a significant difference between time-to-completion during visit 1 and 2, but not visit 2 and 3, suggesting no further improvements. Several measures of reliability have been suggested (Table 2) and all these improve when comparing visits 2-3 versus the evaluation of visits 1-2. The coefficient of variation for visit 1-2 was 10.2% and for visit 2-3 was 3.4% and the 95% limits of agreement for visit 2-3 was 86 s. Test and task completion times did not improve between visit 2 and 3 and the coefficient of variation was <5%. Therefore, the remaining analyses to determine how practice influenced pacing focus upon visits 1 and 2.

<Table 2 about here>

Global Pacing Strategies

Performance times improved during visit 2 (by 12.6 ± 3.6%) and 3 (by 15.7 ± 3.1%) compared to visit 1 (Table 3) and the global pacing strategies employed by the group are depicted in Figure 1a. Specifically, performance improved during tasks one (20 ± 8 s), two (8 ± 4 s), four (39 ± 16 s) and five (22 ± 15 s) and the rest between tasks four and five was longer (75 ± 18 s). The individuals who initially failed (*N*=5), improved on their second visit during tasks one (37 ± 25 s), two (16 ± 12 s), four (86 ± 59 s) and five (88 ± 48 s) and their rest period increased (110 ± 35 s). Peak heart rates occurred earlier on the second visit (176 ± 106 s, $P<0.05$) and average heart rate was lower on the second visit (161 ± 5 versus 158 ± 6 beats.min^{-1}, $P<0.05$) due to an extended rest period (75 ± 62 s longer). However, no significant difference in peak heart rate or average exercising heart rate (Table 4) was observed between visits.

<Table 3 about here>

<Table 4 about here>

<Figure 1 about here>

Within-task pacing strategies

During visit 1, lap one of Task 1 (Figure 2a) was quicker than laps 2-7 (19.9 ± 4.4 %, $P<0.05$) and faster than the remainder of the assessment (by 31.1 ± 4.4%). Similarly, during Task 4 the first lap pair was faster than subsequent lap pairs (by 9.5 ± 5.4%, $P<0.05$). On average, loaded laps during Task 4 were ~13% (± 11 %) slower than unloaded laps but this difference did not reach significance (Figure 2b, $P>0.05$). However, the loaded lap of Task 5 was faster (7.4 ± 16.8 %) than the unloaded return ($P<0.05$). Compared to visit 1, all laps of Task 1 were completed faster (ranging from 6.5 to 15.1% faster) and the loaded laps of Task 4 were quicker (16.9 ± 5.8 %, $p<0.05$) on visit 2 versus visit 1 (Figure 2b). Within visit 2, the first lap of Task 1 was completed faster than laps 2-7 (by 21.3 ± 4.2 %, $P<0.05$) and all other laps of the assessment (by 32.9 ± 4.3 %). Similarly, the first loaded lap of Task 4 was faster than loaded laps 3, 5 and 7 ($P<0.05$) and the first lap pair was 6.7% faster than subsequent laps. Within Task 4, the difference in speed between loaded and unloaded laps was only 3.4 ± 7.8 % (Figure 2b, $P>0.05$). The loaded lap of Task 5 was also quicker (17 ±13 s, $P<0.05$) on visit 2 versus visit 1, while there was no difference on the unloaded return ($P>0.05$).

Compared to visit 1, perceived exertion for Task 5 was lower on visit 2 (14.6 ± 1.0 vs 15.9 ± 1.0, $P<0.05$). There was no difference between visits for Task 6.

<Figure 2 about here>

DISCUSSION

This is the first investigation to examine pacing strategies overall and within sub-tasks of a physiological aptitude assessment with load carriage. All of the participants who were able to complete the assessment chose a fast-start strategy and significantly improved their performance after a single practice trial. This improvement was achieved without any change in fitness (< 1 week between attempts) and suggests that familiarisation with (practicing) test demands and developing a pacing strategy were responsible for the improvement. The greatest gains in performance were observed in sub-task components that required additional external load carriage.

Giving participants the opportunity to practice a test is crucial when the assessment is used as a barrier for employment. Similarly, the assessment needs to be reliable. Indeed systematic bias (a significant difference) existed in the physical aptitude test assessed in the current investigation between the first two visits, however this was reduced with a practice session and the assessment was deemed to have 'good' reliability and precision (84 s for 17 min assessment). This assessment was designed to evaluate the physiological suitability of an individual to work as a firefighter rather than the skill (smooth and superior technique) required to perform the tasks or the ability to select an appropriate pacing strategy. Indeed, practice did not benefit those individuals (N=10) who were unable to complete the assessment on the first occasion as they were also unable to complete it on a second attempt. This is indicative of the physiological aptitude required for tasks one and two (muscular strength, (16, 42)), suggesting some physical conditioning is required prior to attempting the assessment. However, the value of practice was most apparent for individuals (N=5) who completed the assessment but did not met the cut-score on the first attempt yet on their subsequent attempt passed. After one practice attempt, no further improvements were observed, reinforcing that for the assessment to reliably identify individuals possessing sufficient physiological aptitude for firefighting, a practice session is required.

In this investigation, performance times improved by ~12% improvement between the first and second trials of the physical aptitude test; a change consistent with other occupational assessments (10-18%) but larger than seen with athletic (6%) tests (9, 13, 18). Knowledge of the test (duration or distance) has been shown to influence pacing strategies during athletc activities (6, 36, 39). Despite participants having knowledge of the time restrictions of the physical aptitude test, all participants improved their timed performance on the second trial, which suggests knowledge alone was not sufficient to inform their pacing strategy. In contrast to athletic events, during physiological aptitude tests the time standard (end-point) is set to be beaten rather than completing more work for a set duration. This is perhaps in contrast to a model of teleoanticipation for metabolic control (47) which is dependent on an end-point to regulate power output and optimise pacing (21). Furthermore, the physiological demands of the firefighter assessment were unfamiliar to the participants, therefore it was essential that practice was permitted to familiarise individuals with the tasks and physiological demands. Participants improved their practice by learning or modifying their pacing strategy on their second attempt. This allowed participants to optimise performance and increase their pace while avoiding fatigue (an inability to finish the assessment) prior to the exercise end-point (21, 27, 45).

Participants' overall pace increased during visit two, specifically Tasks 1, 2, 4 and 5 were quicker and peak heart rate occurred earlier compared to the first visit. This increase in overall pace is most likely an outcome of increased certainty gained with respect to the assessment end-point (40). Although peak heart rates were attained earlier in the second visit, perceived exertion remained unchanged despite the increase in work output (faster completion time). Typically, perceived exertion is correlated with work output (13, 40, 45) and there are two possible explanations for these disparate results; 1) a change in exercise efficiency, or 2) an uncoupling of perceived exertion with metabolic demand. Given the assessment was novel to the participants, it is possible that improvements after practice were achieved through exercise efficiency (22) and led to the uncoupling of perceived exertion with work output. Considering mean exercising heart rate was not different on the second visit, it is possible there was an increase in exercise efficiency given the greater work output. Perceptions of exertion however, can be inflated by psychological factors such as high anxiety and low self-efficacy (29, 35). Therefore a decrease in anxiety and increase in confidence following the first practice attempt in addition to a small increase in exercise efficiency may explain similar perceived exertion scores recorded between visitations. In addition to changes in global pacing, participants altered their pacing of sub-tasks within the assessment.

To the authors’ knowledge, this investigation represents the first reporting of within-test, task-pacing strategies and our results highlight a fast-start was selected at the onset of tasks. The first lap of Task 1 was ~ 20 % faster than all other laps within Task 1 during both visits one and two, and the first lap pair of Task 4 was ~ 7-9 % faster than subsequent laps. In addition, while it is difficult to compare sub-tasks due to the significant variation in task type, the most rapid pace was consistently observed during Task 1, suggesting a fast-start strategy was a purposeful choice. A fast-start strategy may as such represent the best way to improve performance since during the later tasks in this assessment, accumulated fatigue may influence pace. ATP depletion, metabolite accumulation and afferent feedback can lead to a decrease in central motor drive and reduced power output, in an attempt to avoid peripheral fatigue and systems failure (1, 2, 11, 30, 46), which would negatively affect pace and performance during the later stages of the test. This awareness prompts the brain to modify the pacing strategy (12) and in the present investigation, we suggest the higher initial (first task) pace may have been used to gauge afferent sensation before adjusting pace for the remainder of the task. Participants may also alter their pacing strategy due to opportunities for rest and sub-task physical demands.

We recognise that familiarisation with, or practicing, assessment demands is a well-established method to improve physical performance (5, 9, 18, 34, 38), however this is the first investigation to explore how practice modified participants' pacing within and between disparate sub-tasks of a physiological aptitude assessment. In the present investigation, the preferred fast-start strategy during Tasks 1 and 4 afforded an opportunity for recovery during the third (static) task and increased rest prior to Task 5 given that this task had a fixed 15-min start time. Five participants who initially failed the time-standard for Tasks 5-6 all had < 1 min rest on their first attempt prior to attempting those final two sub-tasks. Whereas on visit 2 those five individuals all selected a fast start by increasing their pace during tasks one, two and four which lengthened their rest period to a greater extent than the whole group. For the whole group, increased rest during visit 2 allowed sufficient recovery and likely reduced cumulative fatigue, which permitted an elevation in work rate during Task 5, coupled with a reduction in perceived exertion. From a metabolic perspective, one would anticipate that a more even distribution of physical effort over the entire 15-min period given for completion of Tasks 1 to 4 would yield improved energy efficiency (7). Yet not one participant selected this option, instead all participants improved performance for Tasks 1-4. This suggests rest opportunities may be crucial for some achieving either a borderline-fail versus a passing score and therefore test order and conduct must be standardised. However, the desire to complete the assessment faster is perhaps unsurprising given that knowledge of a previous performance provides strong motivation to make gains in future attempts (26). Furthermore, the modification of pacing strategies following practice may be influenced by load carriage.

Interestingly, during tasks with both externally-loaded and unloaded laps (tasks 4 and 5), the greatest increase in pace was observed in the loaded laps (Task 4: 17%; Task 5: 20%) and this response was surprisingly consistent across the cohort. We believe these to be new findings. Pacing while carrying load can perhaps be compared to running over variable terrain or cycling into a headwind, where many participants willingly tolerate a higher metabolic cost during the uphill or headwind portion of the task (3, 44). In the current investigation, we observed a ~17% improvement in loaded-lap pace during Task 4. While one previous investigation found a slight increase (~1.2%) in pace during unloaded transitions, it was not possible to determine whether overall performance improved due to improved pace during loaded (6 of 10 tasks) versus unloaded phases since individual task times were not provided (9). In the current investigation, the bias to improve performance during the loaded phase may have been influenced by the assessment constraints (running was not permitted) established *a priori*. Thus, the loaded laps may have represented the greatest opportunity for each participant to increase relative velocity.

Conclusion

During the physiological aptitude assessment examined within this investigation, the experience gained from a single practice trial resulted in significant performance improvements in every individual, with no further gains attained on a third trial. It is well known that individuals completing a physiological aptitude assessment should be given practice (familiarisation) prior to novel tasks to reduce a potential false negative result. However, this is the first investigation to investigate how practice was adapted to modify pacing strategies when performing a physiological aptitude assessment comprised of discretely different tasks involving various forms of load carriage. Increased knowledge of the assessment and sub-task order (gained with practice) had a significant influence upon the way individuals approached this high-stakes barrier assessment, with participants selecting a fast-start and increasing effort on the more difficult, loaded sections of the test. Future research investigating physiological aptitude assessments should consider identifying the key opportunities for improvement and informing applicants. For example, given that running was not permitted in the present assessment, loaded sections of the test provided the greatest opportunity to improve performance and advanced knowledge of this opportunity may increase pass rates.

PRACTICAL APPLICATIONS

Baseline physical conditioning (the ability to lift the mass of objects used in the assessment) is required given that not all individuals passed (n=10), therefore potential applicants should be provided with information on the physical demands prior to assessment. Secondly, since individuals in this investigation improved their performance without an increase in fitness, practice is required to allow individuals to modify their pacing strategy.

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FIGURE LEGENDS

Figure 1: The global pacing strategy of the group. Data are mean and 95% confidence interval. α – laps within brackets are significantly different between visits (P<0.05).

Figure 2: Pacing strategy for the group during: a) Task one (26 kg load carriage); and b) tasks including intermittent load carriage (Task four: hose drag; Task five: fire attack; and Task six: fire-fighter rescue; loaded and unloaded laps are denoted by black and white symbols respectively). Data are presented as mean and 95% confidence interval. Superscripts highlight within-visit differences relative to the denoted lap number (P<0.05). α= laps within brackets different between visits (P<0.05). Bracket δ= faster fire attack than unloaded return for all visits.

Table 1: The six tasks of the firefighter assessment that is required to be passed by recruits

Task number	Task description	Distance	Load carried
1	Unilateral load-carriage: jerry can carried in one hand but could be swapped at any time	195 m over repeated (6×30 m, 1 x 15 m) shuttles	26 kg
2	Unilateral load-carriage: jerry can carried in one hand but could be swapped at any time	36 steps (0.26 m step height)	18.5 kg
3	3 × 40 s bilateral static holds (at eye, hip and mid-calf height) interspersed with 20 s rest. The object replicated the mass and distribution of hydraulic shears used for vehicle extraction.	Static	19 kg
4	Repeated hose drags (2.8 m hose length with nozzle, weighted to 11 kg)	300 m (5 x loaded and 5 x unloaded 30 m laps performed intermittently)	265 N hose drag
5	Height-restricted (maximum 1.25 m vertical height) hose drag	30 m drag and 30 m unloaded return	265 N hose drag
6	Firefighter rescue (maximum 1.55 m vertical height)	10 m	550 N lift and drag

Table 2

Table 2: Measures of reliability comparing visits one-two and visits two-three.

Analysis	Visit 1-2	Visit 2-3
Repeated measures ANOVA (F = 18.48, *P* <0.01)	*P* <0.01	*P* = 0.84
Effect size (95% confidence interval)	0.75 (0.14 to 1.34)	0.23 (-0.36 to 0.80)
Pearson's correlation (r)	0.900	0.905
Regression (r^2)	0.810	0.820
Intraclass correlation (ICC) (95% confidence interval)	0.756 (0.532 to 0.881)	0.905 (0.808 to 0.956)
Standard error of measurement	40 s (5.2 %)	11 s (1.6 %)
Co-efficient of variation (%)	10.2	3.4

Table 3: Average completion times and relative performance improvements (%) for each individual task and for the cumulated test.

Task	**Visit 1 (s)**	**Visit 2 (s)**	**Visit 3 (s)**	**Visit 1 vs. 2** **Δ% (95% CI)**	**Visit 2 vs. 3** **Δ% (95% CI)**
1	144 ± 16	124 ± 13	122 ± 13	12.4 ± 6.0 %*	1.0 ± 4.6 %
2	88 ± 21	70 ± 5	70 ± 7	10.2 ± 5.4 %*	1.1 ± 4.3 %
4	283 ± 31	243 ± 17	248 ± 32	11.7 ± 4.9 % *	3.5 ± 3.7%
Rest	194 ± 47	267 ± 38	286 ± 40	36.6 ± 14.9% *	10.3 ± 10.0 %
5	81 ± 20	57 ± 6	51 ± 4	17.8 ± 10.0 % *	7.1 ± 7.6 %
6	17 ± 3	14 ± 2	14 ± 2	4.2 ± 11.3 %	-5.3 ± 12.0 %
Test completion	820 ± 78	704 ± 42	693 ± 49	12.6 ± 3.6 %*	3.3 ± 2.6 %

* statistical difference (*P*<0.05). Time is given in seconds (s), and the relative change in performance (Δ%) with the 95% confidence intervals (95% CI) are given.

Table 4: Average and peak heart rate, time to peak heart rate and rating of perceived exertion (RPE) during visits one and two.

	Visit 1	Visit 2
Average heart rate (bpm)	161 ± 5	158 ± 6*
Average heart rate excluding rest (bpm)	167 ± 5	165 ± 5
Peak heart rate (bpm)	188 ± 4	186 ± 5
Time to peak (s)	603 ± 107	427 ± 99*
RPE Task1	13.1 ± 0.9	12.7 ± 0.9
RPE Task2	14.0 ± 0.8	14.5 ± 0.6
RPE Task3	15.1 ± 0.8	14.9 ± 0.8
RPE Task4	16.8 ± 0.9	17.0 ± 0.8
RPE Task5	15.9 ± 1.0	14.6 ± 1.0*
RPE Task6	16.5 ± 1.1	16.2 ± 1.0

Data given as mean ± 95% confidence intervals. *statistical difference between visits

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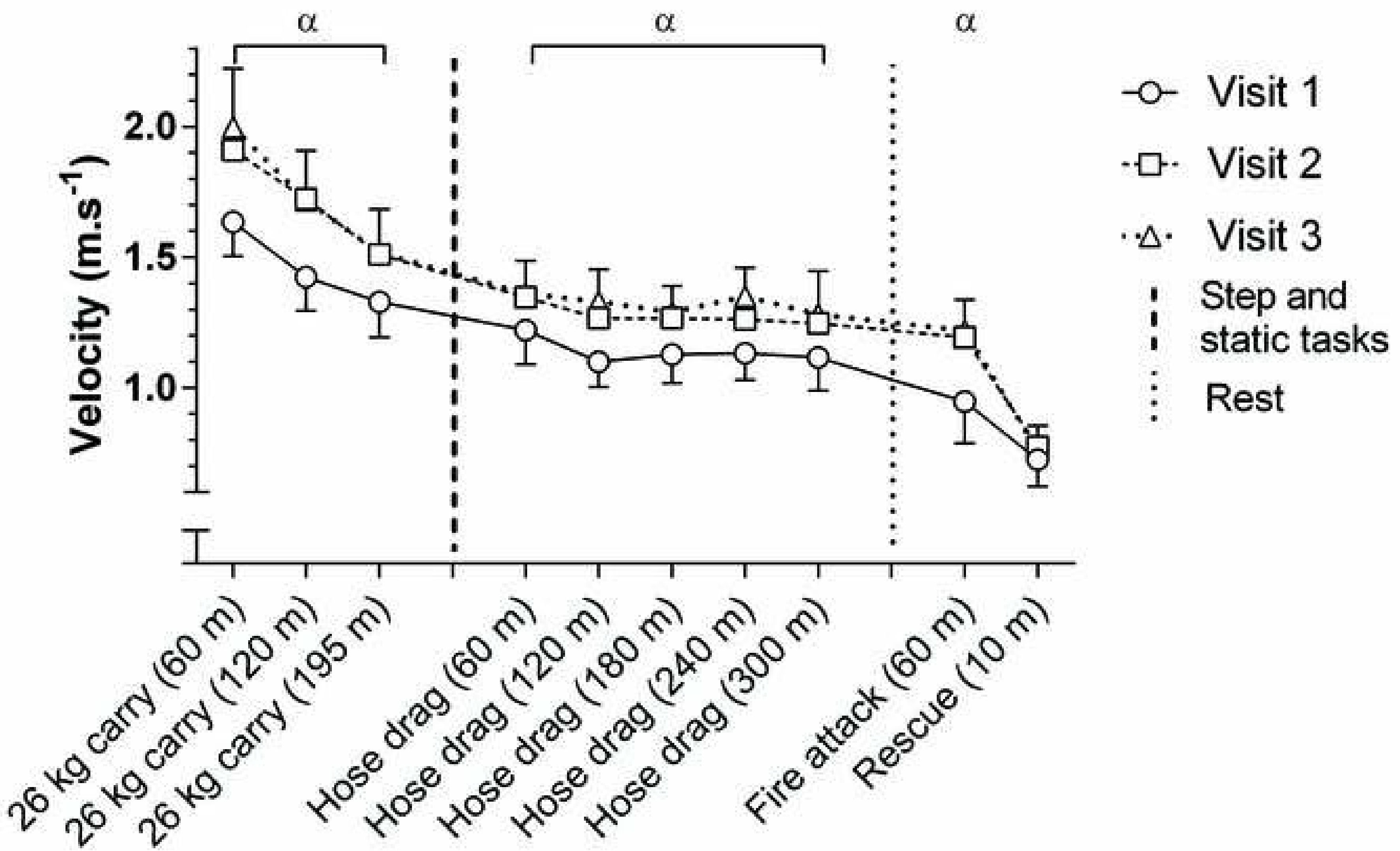

Figure 2

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