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Original Research

Biddle Physical Ability Test (BPAT) Performance by Attempt in Southern California Structural Firefighter Candidates

Robert G. Lockie‡[1], Joseph M. Dulla†[2], Jennifer Meloni‡[3], Kristina A. Ross‡[3], Robin M. Orr‡[2], J. Jay Dawes‡[4,5], and Tomas J. Ruvalcaba†[3,6]

[1]Center for Sport Performance, Department of Kinesiology, California State University, Fullerton, Fullerton, CA, USA; [2]Tactical Research Unit, Bond University, Robina, Qld, Australia; [3]Fire Technology Department, Santa Ana College, Santa Ana, CA, USA; [4]School of Kinesiology, Applied Health and Recreation, Oklahoma State University, Stillwater, OK, USA; [5]Tactical Fitness and Nutrition Lab, Oklahoma State University, Stillwater, OK, USA; [6]Human and Sport Performance, Rocky Mountain University, Provo, UT, USA

†Denotes early-career investigator, ‡Denotes established investigator

Abstract

International Journal of Exercise Science 18(8): 895-909, 2025. https://doi.org/10.70252/LGER1776 The Biddle Physical Ability Test (BPAT) is a job task simulation that must be completed in ≤9:34 min:s by structural firefighter candidates to be accepted to a fire training academy. This study investigated the influence of prior attempts on BPAT time. Retrospective analysis was conducted on 1435 male and 72 female candidates. All participants received equivalent instruction on how to complete the BPAT which incorporated: dry hose drag; charged hose drag; halyard raise; roof walk; attic crawl; roof ventilation; victim removal; ladder removal and carry; stair climb with hose bundle; crawling search; stair climb with air bottles; and hose hoist. Candidates in the dataset were split into 1st, 2nd, 3rd, 4th, 5th, and ≥6th attempt groups. A one-way ANOVA, with Bonferroni post hoc, compared groups in BPAT time (all times combined and passing times only; $p \leq 0.05$). All candidates who failed to meet time requirements, did not finish, or were disqualified, were recorded. The 1st, 2nd, and 3rd attempt groups were significantly ($p \leq 0.007$) slower than the 4th, 5th, and ≥6th attempt groups when considering all and passing times. The percentage of candidates that did not pass the BPAT relative to their attempt group was: 1st = 13%; 2nd = 6%; 3rd = 7%; 4th = 2%; 5th = 0%; ≥6th = <1%. Most candidates passed the BPAT. However, BPAT practice based on previous attempts generally led to faster times and more candidates passing. It could be beneficial for candidates to attend practice courses and fitness training sessions to improve BPAT performance.

Keywords: Fire department, firefighting, job task, occupational testing, physical ability test, tactical

Introduction

Firefighters perform numerous challenging tasks within their profession, which include carrying equipment, operating hose lines, stair climbing, forcible entries, ladder raises, crawling,

and victim or casualty drags.[1-4] The environments that firefighters work in and the required load carriage (personal protective equipment, self-contained breathing apparatus) makes job task completion even more physically demanding.[4,5] Indeed, firefighters may have to work in environments where temperatures exceed 500˚C, all while wearing loads that can be greater than 20 kg.[6] As a result of these demands, individuals that want to pursue a career in firefighting will typically perform physical ability testing before they are accepted to a training academy. Physical ability testing is used to identify the potential readiness of candidates to complete job-specific tasks.[3,7]

Many states in the United States of America (USA) mandate that candidates complete the nationally recognized Candidate Physical Ability Test (CPAT) to be accepted to a fire training academy.[8] The CPAT simulates and measures numerous job tasks, including a stair climb, hose drag, equipment carry, ladder raise and extension, forcible entry, search, rescue drag, and ceiling breach and pull.[8,9] For states that do not mandate the CPAT, candidates generally still have to complete some form of physical ability testing.[10] Some fire departments will also require candidates to complete the Biddle Physical Ability Test (BPAT) as part of the application process. The BPAT was developed and validated across 41 fire departments as a readiness assessment for entry-level firefighter candidates.[11,12] Eleven simulated job tasks are included in the BPAT: dry and charged hose drag; halyard raise, roof walk, and attic crawl; roof ventilation and victim removal; ladder removal and carry; stair climb with hose bundle; crawling search and tower exit; stair climb with air bottles; hose hoist; and return to ground floor with air bottles.[11,12] The 11 tasks are performed consecutively and must be completed in ≤9:34 minutes:seconds (min:s) (≤574 s).

Candidates do not have to complete any specific practice or training before attempting the BPAT, even though firefighting equipment can be difficult to manipulate. For example, firefighter training staff have reported how some candidates find carrying and manipulating ladders very challenging.[12] Certain community colleges will have semester-long (i.e., 16 weeks) classes that are targeted towards improving BPAT performance via physical conditioning and skill acquisition. Lockie, et al[12] investigated the differences in overall, and by event, BPAT times in candidates who completed or did not complete a training class. While there were no significant differences between the groups, moderate differences were found for the faster roof ventilation and victim removal (d = 0.89), ladder removal and carry (d = 0.95), and the hose hoist (d = 0.74) by candidates who completed a training class. Moreover, candidates who completed a training class performed the BPAT 5% faster than those that did not. Lockie, et al[12] attested these results to potential fitness and skill development and suggested that candidates lacking in certain fitness characteristics (e.g., the strength to carry and manipulate a ladder) would benefit from college training class attendance and practice with specific job tasks. This supposition is buttressed by the work of Schram et al,[13] who found improvements in police candidate fitness test performance following a single session of test familiarization. Female police candidates significantly (p < 0.001) improved push-up (1.4 ± 2.3 repetitions to 2.0 ± 2.6 repetitions), sit-up (14.5 ± 4.0 repetitions to 18.5 ± 3.6 repetitions), standing broad jump (145.7 ± 24.2 cm to 151.2 ± 24.3 cm), vertical jump (22.5 ± 8.1 cm to 26.4 ± 5.1 cm), and motor educability test (20.5 ± 5.3

errors to 10.4 ± 6.0 errors) performance following a practice trial, feedback about common errors, and recommendations for better performance.[13]

Training classes are not mandatory for candidates. Moreover, candidates are also allowed as many attempts as they wish to complete the BPAT, depending on available testing locations (e.g., some colleges may offer BPAT testing once per month) and the candidate's willingness to pay the testing fee.[14] Although having a candidate complete multiple testing attempts could increase the money received by a testing location, many fire departments are experiencing recruitment challenges.[15] It could be expected that a department would prefer to move a candidate into their employment pipeline sooner rather than later. A candidate that must attempt the BPAT multiple times would extend the time needed for hiring, while also potentially increasing the risk of losing that candidate.

It is plausible that the more attempts a candidate has (i.e., greater familiarity and potential practice), the faster their completion time will be, and the less likely they will be to fail the BPAT. A candidate who has failed the BPAT several times may also undergo more fitness and skill-specific training in order to pass the BPAT in a later attempt. Analyzing BPAT performance by attempt in structural firefighter candidates could highlight the value of practice with this physical ability test. Therefore, the purpose of this study was to investigate the influence of prior attempts on BPAT time. The dataset provided to researchers was de-identified and did not allow for multiple BPA attempt to be linked to an individual candidate. Nonetheless, the cross-sectional analysis of data grouped by attempt can still provide insight into the potential value of candidate practice and exposure to an occupational physical ability test used in the hiring process for firefighters. The current study could help show the need for appropriate training to limit loss of candidates, which is necessary given the hiring and retention challenges for many fire departments around the country.[15] We hypothesized that slower BPAT times would be recorded the by the candidates who completed fewer attempts. We further hypothesized that completing more attempts at the BPAT would result in a lower relative number of candidates who could not make the passing time.

Methods

Participants

De-identified archival data for 1507 structural firefighter candidates (age: 27 ± 6 years; height: 1.80 ± 0.07 m; body mass: 83.26 ± 11.77 kg) were analyzed. The dataset included 1435 men (age: 27 ± 6 years; height: 1.80 ± 0.07 m; body mass: 84.01 ± 11.37 kg) and 72 women (age: 25 ± 6 years; height: 1.68 ± 0.10 m; body mass: 68.24 ± 9.58 kg). This was a convenience sample of archival data provided by the community college staff, and the researchers had no control of the final sample size used in this investigation. For candidate data to be included, full datasets had to be available. Based on the archival nature of this analysis, the institutional ethics committee approved the use of pre-existing data (HSR-20-21-58). The research was still conducted in agreement with the ethical standards of the *International Journal of Exercise Science*.[16]

Protocol

The procedures for BPAT data collection have been described by Lockie, et al[12], but will be detailed here. Data were collected by staff working for one community college fire training program and released with consent from that organization. Before testing, age, height, and body mass of candidates were recorded. Candidates completed the BPAT at an outdoor fire station training facility, with weather conditions typical of southern California.[17] The candidates typically reported to the facility for a 7:30am start, and the session lasted for about 4 hours.[14] Staff were instructed to subjectively record the weather conditions during their testing sessions ('Hot', 'Warm', 'Cool', 'Wet', or 'Windy'). Accordingly, the testing conditions could have varied across the candidates in this sample. Nonetheless, the data collected became part of official records for the community college program and was used for employment decisions about the candidates. Candidates wore athletic clothes and shoes, a turnout coat, helmet, gloves, and breathing apparatus worn on the back with no mask. A candidate could use their own firefighting gear as listed above if it was approved by staff, but otherwise, the gear was provided to candidates.

Table 1. The 11 tasks or events completed within the Biddle Physical Ability Test (BPAT).[12]

Task	Description
1. Dry hose deployment	Candidate advanced 150-feet (45.72-m) of 1.75-inch (4.45-cm) dry hose with nozzle around two obstacles.
2. Charged hose deployment	Candidate advanced a charged 1.75-inch (4.45-cm) hose with nozzle 70 feet (21.34 m); 32 feet (9.75 m) of hose deployment involved stooping or crawling while advancing hose into a narrowing hallway.
3. Halyard raise	Candidate raised and lowered fly section of a 35-foot (10.67-m) aluminum extension ladder one time.
4. Roof walk	Candidate ascended and descended a 14-foot (4.25-m) ladder attached to a simulated-pitched roof with a chain saw in hand.
5. Attic crawl	Candidate crawled 20 feet (6.10 m) across a simulated attic-joist floor, while carrying a simulated flashlight in hand.
6. Roof ventilation	Candidate stood on a simulated-pitched roof and struck a padded area 30 times with an 8-pound (3.63-kg) sledgehammer.
7. Victim removal	Candidate carried or dragged a 154-pound (69.85-kg) dummy around two obstacles 13 feet (3.96 m) apart.
8. Ladder removal and carry	Candidate removed a 24-foot (7.32-m) aluminum extension ladder from mounting bracket, carried ladder around a diamond shaped course 54 feet (16.46 m) long and replaced ladder back on mounting brackets.
9. Stair climb with hose pack	Candidate ascended to fourth floor of tower using stairs while carrying a 49-pound (22.23-kg) hose pack. Candidate dropped hose pack and begun task 10. Candidate descended tower using stairs to first floor carrying hose pack.
10. Attic crawl	Candidate crawled on hands and knees on fourth floor of the tower for 60 feet (18.29 m). This was done when candidate was performing task 9.
11. Hose hoist	Candidate ascended to third floor of tower using stairs, carrying 2 air bottles weighing 29 pounds (13.15 kg) (connected with a 2-foot [0.61-m] strap). After dropping off air bottles, candidate then hoisted up a 100-foot (30.48-m) section of extended 1.75-inch (4.45-cm) hose line with nozzle, up and through window, picking up air bottles and descended tower to finish line.

With regards to advance knowledge of the BPAT, the researchers cannot state that all participants had the same experience, training, practice, or knowledge of this ability test. Candidates had the opportunity to enroll in a class at the community college to train for and practice the BPAT; however, it is not mandatory for them to do so.[12] The community college fire training program has a webpage that provides links to a video and descriptions of the BPAT events,[14] so it could be assumed the majority of candidates have at least reviewed this material before their testing session/s.

Within their testing session, candidates completed the BPAT in alphabetical order according to their last name. All candidates received instructions on how to complete the BPAT and were told to complete the test as fast as possible, with the tasks shown in Table 1. These tasks were completed successively, with an expected completion time of ≤9:34 min:s. A staff member recorded the time to complete the BPAT via a stopwatch.[12] Candidates failed the BPAT if their time exceeded 9:34 min:s, they were disqualified by failing to correctly complete a task (e.g., rope slippage during the halyard raise, dropping or losing control of the ladder),[18] or they did not finish. In some instances, candidates who failed the BPAT for any reason were not provided a final time. Candidates were only allowed one attempt at the BPAT during the session.

Statistical Analysis

After reviewing the dataset, candidates were split into six groups: 1st attempt, 2nd attempt, 3rd attempt, 4th attempt, 5th attempt, and 6th or more (≥6) attempt. It is possible that the same candidate may have been present in multiple groups. For example, if a candidate failed their first attempt and reattempted the BPAT, they would be present in the 1st attempt and 2nd attempt groups. If a candidate failed their first and second attempts and applied again for a third attempt, they would be in the 1st attempt, 2nd attempt, and 3rd attempt groups, and so on. To reiterate, the data provided to researchers was de-identified, so there was no way of tracking an individual across multiple BPAT attempts. Nonetheless, the greater consideration in this study was to provide a cross-sectional analysis of how candidates performed relative to how many times they had previously attempted the BPAT. Descriptive statistics (mean ± standard deviation [SD]) were calculated for age, height, body mass, and BPAT time for each attempt group. Two analyses were conducted; one investigating all candidates who recorded a BPAT time, and one that only considered candidates who recorded a passing time (i.e., ≤9:34 min:s or 574 s). In both instances, four one-way analysis of variance (ANOVA) analyses were used to calculate differences in age, height, body mass, and BPAT time between the attempt groups, with significance set as $p \leq 0.05$. These types of analyses were conducted due to the size of the sample, and the robustness of the one-way ANOVA.[19,20] If a significant F ratio was detected, post hoc tests were performed using the Bonferroni adjustment procedure. Partial eta-squared (η^2) effects sizes were reported for the one-way ANOVA interactions, with the strength of η^2 defined as: 0.09, small; 0.14, medium; and 0.22 or greater, large.[21] For pairwise comparisons, Cohen's d effect sizes were calculated, where the difference between the means was divided by the pooled SD.[22] A d <0.2 was a trivial effect; 0.2-0.6, a small effect; 0.6-1.2, a moderate effect; 1.2-2.0, a large effect; 2.0-4.0, a very large effect; and 4.0≥, an extremely large effect.[23] Lastly, the number of candidates who passed the BPAT, failed the BPAT due to time, or failed the BPAT

because they were disqualified or did not finish, were derived by sex for each attempt group. All statistical analyses were computed using the Statistics Package for Social Sciences (version 28.0; IBM Corporation, NY, USA) and Microsoft Excel (Microsoft Corporation™, Redmond, Washington, USA).

Results

The one-way ANOVA results indicated that there were significant interactions for age (F_5 = 22.535, p < 0.001, ηp^2 = 0.026, small effect), body mass (F_5 = 3.683, p = 0.003, ηp^2 = 0.012, small effect), and BPAT time (F_5 = 56.574, p < 0.001, ηp^2 = 0.164, medium effect), but not height (F_5 = 1.608, p = 0.155, ηp^2 = 0.005, small effect) (Table 2 and Figure 1). There was only one significant pairwise difference for age; candidates in the ≥6th attempt group were significantly older than candidates from all other attempt groups ($p \leq 0.011$; d = 0.33-0.55; small effects). For body mass, the ≥6th attempt group was significantly heavier than the 1st attempt (p = 0.002; d = 0.31; small effect) and 5th attempt (p = 0.012; d = 0.43; small effect) groups. With regards to BPAT time (Figure 1), the 1st attempt group was significantly (p < 0.001) slower than all other attempt groups. The effect sizes for the between-group comparisons ranged from small to large (2nd attempt d = 0.33; 3rd attempt d = 0.41; 4th attempt d = 0.84; 5th attempt d = 1.18; ≥6th attempt d = 1.25). The 2nd attempt group was significantly (p < 0.001) slower than the 4th (d = 0.51; small effect), 5th (d = 0.85; moderate effect), and ≥6th (d = 0.90; moderate effect) attempt groups. The 3rd attempt group was significantly slower than the 4th (p = 0.003; d = 0.39; small effect), 5th (p < 0.001; d = 0.70; moderate effect), and ≥6th (p < 0.001; d = 0.76; moderate effect) attempt groups. The 4th attempt group was significantly (p = 0.048; d = 0.38; small effect) slower than the ≥6th attempt group. There were no significant differences between the 5th and ≥6th attempt groups (p = 1.000; d = 0.06; trivial effect).

Table 2. Descriptive data of candidates who recorded a time (pass and fails) for the Biddle Physical Ability Test (BPAT) by attempt.

	Age (years)	Height (m)	Body Mass (kg)
1st Attempt (n = 508)	27 ± 5	1.79 ± 0.07	82.34 ± 11.21
2nd Attempt (n = 234)	27 ± 5	1.80 ± 0.07	83.67 ± 12.23
3rd Attempt (n = 266)	26 ± 6	1.79 ± 0.07	83.25 ± 12.54
4th Attempt (n = 127)	27 ± 5	1.80 ± 0.07	83.50 ± 11.63
5th Attempt (n = 94)	27 ± 6	1.79 ± 0.08	81.06 ± 10.86
≥6th Attempt (n = 224)	29 ± 6*	1.81 ± 0.08	85.90 ± 11.72#

* Significantly ($p \leq 0.05$) different from all other groups. # Significantly ($p \leq 0.05$) different from the 1st and 5th attempt groups.

Descriptive data for the attempt groups for only candidates that recorded a passing time is shown in Table 3, while the BPAT times are displayed in Figure 2. Again, the one-way ANOVA results indicated that there were significant interactions for age (F_5 = 6.268, p < 0.001, ηp^2 = 0.022, small effect), body mass (F_5 = 2.910, p = 0.013, ηp^2 = 0.010, small effect), and BPAT time (F_5 = 62.984, p < 0.001, ηp^2 = 0.184, medium effect), but not height (F_5 = 0.927, p = 0.462, ηp^2 = 0.003, small effect). The ≥6 attempt group was older than all other attempt groups ($p \leq 0.021$; d = 0.33-0.50; small effects). This group was also heavier than the 1st attempt (p = 0.050; d = 0.24; small effect) and 5th attempt (p = 0.009; d = 0.42; small effect) groups. The BPAT time comparison

results for candidates who passed produced similar results for when all candidates who recorded a time were analyzed. The 1st attempt group was significantly ($p < 0.001$) slower than all other attempt groups. The effect sizes for the between-group comparisons also ranged from small to large (2nd attempt $d = 0.38$; 3rd attempt $d = 0.50$; 4th attempt $d = 0.85$; 5th attempt $d = 1.17$; ≥6th attempt $d = 1.31$). The 2nd attempt group was significantly ($p < 0.001$) slower than the 4th ($d = 0.48$; small effect), 5th ($d = 0.79$; moderate effect), and ≥6th ($d = 0.92$; moderate effect) attempt groups. The 3rd attempt group was significantly slower than the 4th ($p = 0.007$; $d = 0.37$; small effect), 5th ($p < 0.001$; $d = 0.68$; moderate effect), and ≥6th ($p < 0.001$; $d = 0.81$; moderate effect) attempt groups. The 4th attempt group was significantly slower than the ≥6th attempt group ($p = 0.008$; $d = 0.39$; small effect). There were no significant differences between the 5th and ≥6th attempt groups ($p = 1.000$; $d = 0.09$; trivial effect).

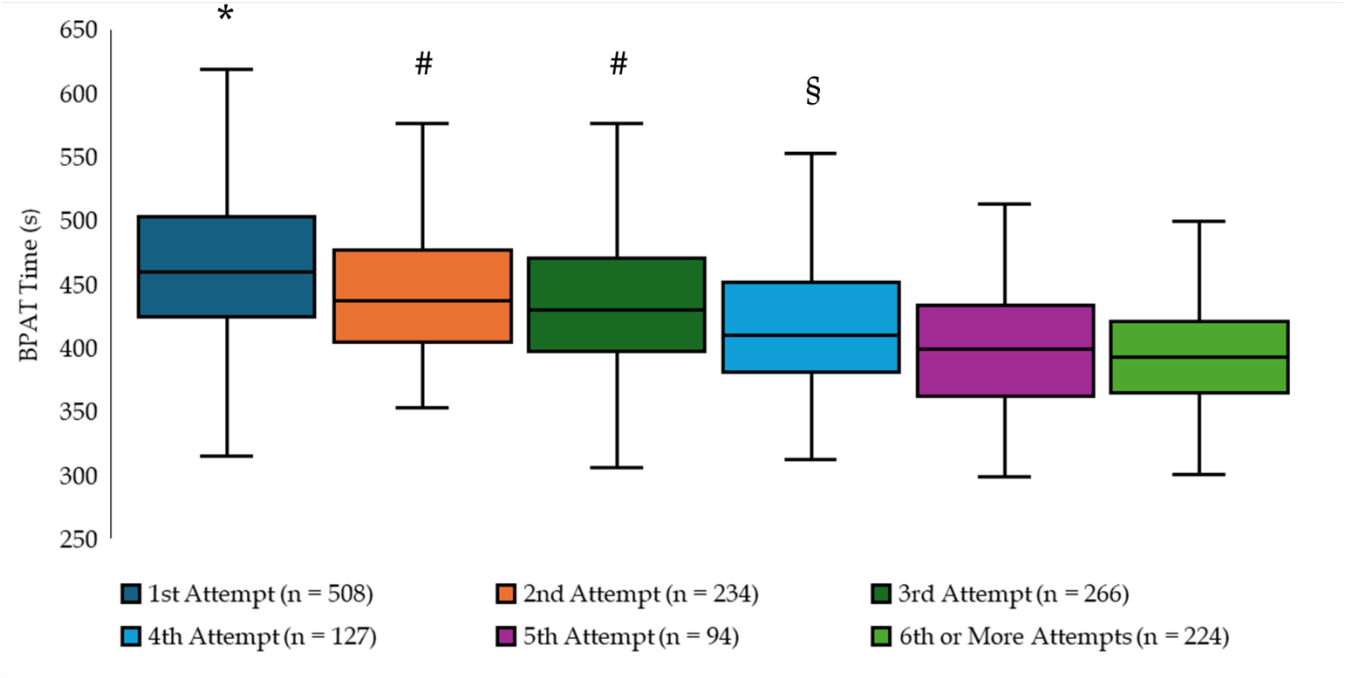

Figure 1. Box plots of Biddle Physical Ability Test (BPAT) times by attempt for all candidates who recorded a time (pass and fails). * Significantly ($p \leq 0.05$) slower than all other attempt groups. # Significantly ($p \leq 0.05$) slower than the 4th, 5th, and ≥6th attempt groups. § Significantly ($p \leq 0.05$) slower than the ≥6th attempt group.

Table 3. Descriptive data of candidates who recorded a passing time for the BPAT by attempt.

	Age (years)	Height (m)	Body Mass (kg)
1st Attempt (n = 477)	27 ± 5	1.80 ± 0.07	83.11 ± 10.14
2nd Attempt (n = 224)	27 ± 5	1.81 ± 0.06	84.12 ± 11.52
3rd Attempt (n = 257)	26 ± 6	1.80 ± 0.07	83.71 ± 12.39
4th Attempt (n = 126)	27 ± 5	1.81 ± 0.07	83.82 ± 11.43
5th Attempt (n = 94)	27 ± 6	1.79 ± 0.08	81.06 ± 10.86
≥6th Attempt (n = 223)	29 ± 6*	1.81 ± 0.08	85.78 ± 11.61#

* Significantly ($p \leq 0.05$) different from all other groups. # Significantly ($p \leq 0.05$) different from the 1st and 5th attempt groups.

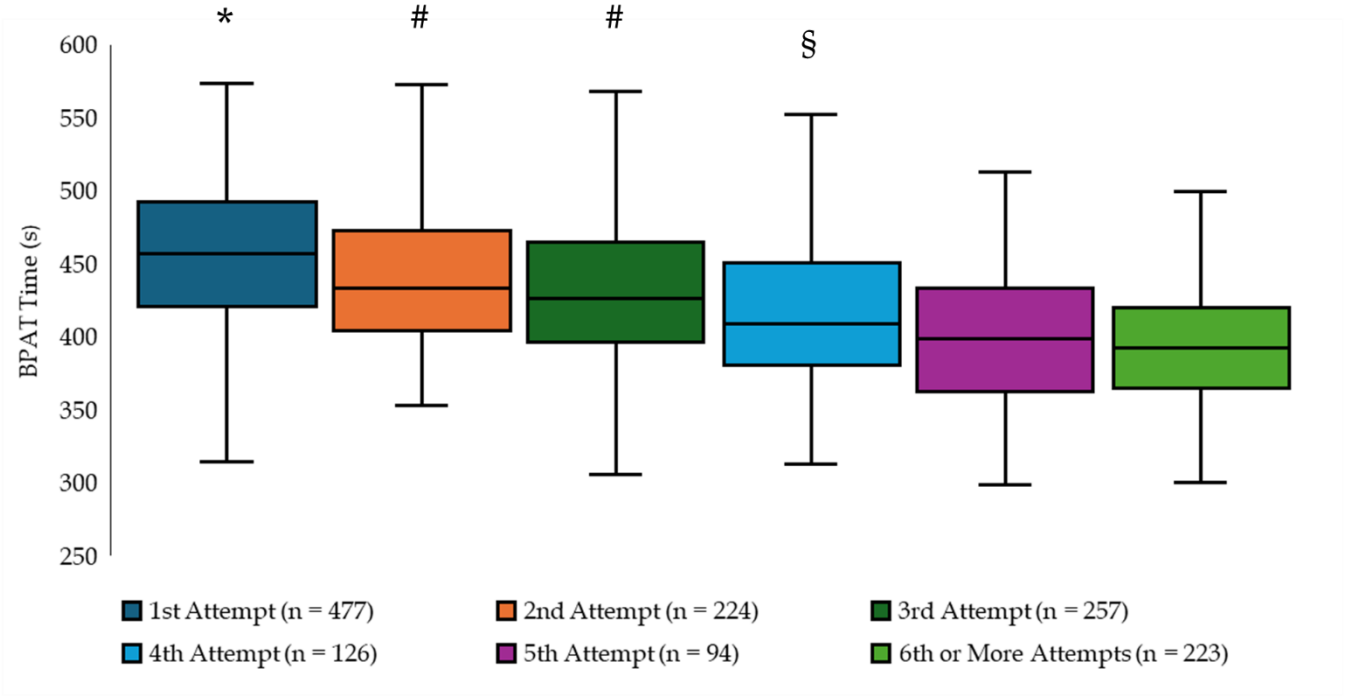

Figure 2. Box plots of Biddle Physical Ability Test (BPAT) times by attempt (passing times only). * Significantly ($p \leq 0.05$) slower than all other attempt groups. # Significantly ($p \leq 0.05$) slower than the 4th, 5th, and ≥6th attempt groups. § Significantly ($p \leq 0.05$) slower than the ≥6th attempt group.

The number of candidates who passed the BPAT, or failed the BPAT due to time, or they did not finish or were disqualified, is shown in Table 4. Irrespective of the number of previous attempts, passing rates were all above 87% of the sample, with 1401 candidates passing the BPAT. The percentage of candidates that did not pass the BPAT, grouped by attempt, was 1st attempt = 13%; 2nd attempt = 6%; 3rd attempt = 7%; 4th attempt = 2%; 5th attempt = 0%; 6 or more attempts = <1%.

Table 4. Number (overall and by sex) and percentage of candidates who passed the Biddle Physical Ability Test (BPAT), failed the BPAT with a slow time, or failed the BPAT via did not finish (DNF) or disqualification (DQ).

	Passed	Failed – Time	Failed – DNF or DQ
1st Attempt	477 / 87% (469 men, 8 women)	31 / 6% (23 men, 8 women)	39 / 7% (21 men, 18 women)
2nd Attempt	224 / 94% (220 men, 4 women)	10 / 4% (4 men, 6 women)	4 / 2% (2 men, 2 women)
3rd Attempt	257 / 93% (251 men, 6 women)	9 / 3% (5 men, 4 women)	10 / 4% (7 men, 3 women)
4th Attempt	126 / 98% (122 men, 4 women)	1 / 1% (1 woman)	1 / 1% (1 woman)
5th Attempt	94 (100%) (91 men, 3 women)	0	0
≥6th Attempt	223 / >99% (219 men, 4 women)	1 / <1% (1 man)	0

Discussion

This study investigated the influence of prior attempts on the proficiency to pass the BPAT in structural firefighter candidates. We hypothesized that slower BPAT times would be recorded by the candidates who completed fewer attempts. We further hypothesized that completing more attempts at the BPAT would result in a lower relative number of candidates who could not make the passing time. Both hypotheses were supported by the results from this study. When considering all BPAT times and only passing BPAT times, the 1st, 2nd, and 3rd attempt groups were all slower than the 4th, 5th, and ≥6th attempt groups. Moreover, the relative percentage of candidates who did not pass the BPAT tended to decrease across the attempts (from 13% for the 1st attempt, to <1% for the ≥6 attempts). Nevertheless, it must be noted that most candidates (87-100%) passed the BPAT across the attempts, and the mean values for each attempt group was under the passing requirement. The majority of candidates likely had the fitness and skill to complete the BPAT by the required time of ≤9:34 min:s, or ≤574 s.[11,12] For those candidates who could not complete the BPAT in the required time in their initial attempts, the data appear to support the value of practice and familiarity with the tasks required in the BPAT, given the faster time across attempts and the overall pass rate of 93% (1401 out of 1507 candidate). Of note, however; if no subsequent attempts were allowed after the first attempt, this would have resulted in a net loss of 924 candidates (1401 who passed overall vs. 477 who passed at their first attempt). Accordingly, even if someone does not pass their initial attempts at the BPAT, appropriate skill and fitness development should limit net training liability loss of candidates. This is important given the hiring and retention challenges for many fire departments around the country.[15]

The majority of candidates for all attempts still recorded a passing BPAT time. The lowest percentage was observed for the first attempt, and this still had an 87% passing rate (477 candidates). Having a high number of candidates pass an entry barrier is essential for fire departments that may be experiencing recruitment and retention difficulties.[15] Given the need for candidates to also pass the CPAT,[8] it could be surmised that many of the candidates had at least some degree of fitness because of this requirement. Indeed, multiple fitness traits (anaerobic and aerobic fitness, muscular strength, power, and endurance) relate to faster performance of the CPAT.[2,24] Even though skill proficiency can influence firefighter task performance, certain tasks can be successfully performed if an individual has the requisite capacity (e.g., strength, aerobic or anaerobic fitness).[12] As physical ability testing is used to discern the readiness of candidates to complete job-specific tasks,[3,7] the majority of candidates from this study would likely have the capacity to complete physically demanding tasks during academy training and on the job.

There were candidates who required multiple attempts to pass the BPAT. As reflected, however, candidates completing 4 or more attempts were faster than those who had completed 1-3 attempts, with moderate-to-large effects. It should be noted that these candidates likely contributed to the slower mean BPAT times for the 1-3 attempt groups as they did not achieve the time requirements with their previous attempts. Nonetheless, for the candidates requiring 4 or more attempts, it is plausible that greater exposure and familiarity to the firefighting-specific

skills required in the BPAT contributed to these meaningfully faster times. Although speculative, candidates that required multiple attempts at the BPAT may have completed fitness and skill training to better prepare for subsequent BPAT attempts. Specific to community college training classes, Lockie et al[12] noted that the physically challenging tasks of roof ventilation and victim removal, ladder removal and carry, and the hose hoist, were completed 7-19% faster by candidates who completed a training class. Several studies have also demonstrated that multiple components of fitness can be improved via specific training programs in firefighter trainees or recruits.[25-27] Nonetheless, what these data could demonstrate is that greater practice and familiarity with the BPAT could lead to improvements in specific job task performance. Although fitness testing data would be needed to confirm this supposition, candidates with potential but not the current skill or fitness could be encouraged to enroll in specific community college classes or complete strength and conditioning programs that could improve their fitness specific to firefighting. Completion of this type of practice and training could aid successful completion of the BPAT.

While candidates only had to surpass the minimum time of 9:34 min:s (574 s) for the BPAT, faster performance should not be underestimated. Lockie, et al[12] noted that completion time in firefighting tasks is often used to measure successful task performance. In the study by Lockie et al,[12] 29 of the 32 candidates passed the BPAT on their first attempt, and in the context of using this test as an entry to academy training, they had a successful performance. The use of completion time as a measure of success can be made in part as any other definition of success related to the destruction of property or potential fatalities is difficult to quantify as acceptable.[28,29] Thus, even for candidates who may have passed the BPAT, exposure to skill acquisition and fitness training that could improve firefighting job task performance should be actively encouraged. Candidates with better anaerobic and aerobic fitness, and muscular strength, power, and endurance, would also be in a better position to complete the demands of academy training and successfully graduate and become a firefighter.[9] Accordingly, candidates with passing BPAT times should still aim to develop the requisite fitness and motor abilities that could benefit their future firefighting career.

In this study, there were no significant differences in time between the 5th and ≥6th attempt groups, with trivial effects. A ceiling effect may have been reached following this number of attempts in the candidates. It is also possible that candidates that did not have the capacity to pass the BPAT after several earlier attempts may not have returned to attempt it again, which led to an overall faster mean time. What was also notable about the ≥6th attempt group in both the all and passing time analyses was that they were significantly older than all the other attempt groups, and heavier than the 1st and 5th attempt groups, although the effects were small. Body size can be a factor in tasks requiring absolute strength,[30] so this could have benefited candidates when performing lifting tasks in the BPAT (e.g., charged hose deployment, ladder removal and carry, victim drag). However, if these relatively heavier candidates did not have acceptable relative strength, their performance in the BPAT could have been compromised. Indeed, relative strength measured by the leg/back dynamometer in highway patrol officers,[31] and the isometric mid-thigh pull in firefighters,[32] has been found to relate to power as measured by countermovement jump height (r = 0.556 and 0.519, respectively). Although fitness test data

would be needed to confirm, any improvements in relative strength, should the body mass of the heavier candidates remain relatively constant, could then positively contribute to BPAT performance.[32] The larger consideration for the ≥6th attempt group was the mean age of the candidates, although it should be acknowledged that the difference only had a small effect. Nonetheless, if BPAT testing is potentially only available once per month,[14] completion of 6 attempts could mean a minimum of 6 months between the first and final passing test for a candidate. This means at least half a year, and perhaps longer, before a candidate becomes an option for a fire department. Given current recruitment challenges,[15] extending the hiring process for a candidate is not beneficial for a fire department. Earlier practice, skill acquisition, and fitness interventions for viable candidates would be optimal for fire departments, such that multiple attempts at a physical ability test like the BPAT are not required.

The current data when considering the number of men and women are reflective of the profession; in 2020, approximately 9% of all firefighters in the USA were women.[33] This is in part due to the physical demands of the profession, and numerous studies have shown men tend to outperform women in tests of strength, anaerobic, and aerobic fitness in firefighting populations.[34-36] However, many fire departments are attempting to recruit more women into their workforce,[37,38] but only 5% (72/1507) of the total candidate dataset were women. Nonetheless, we noted that more women failed their first three attempts at the BPAT than passed. To be specific, 77% of the sample of women failed their first attempt at the BPAT; 67% failed the second attempt; and 54% failed the third attempt. In contrast, only 9% of the sample of men failed their first BPAT attempt; 3% failed their second attempt; and 5% failed their third attempt. The relative number of females who did not pass the BPAT with subsequent attempts did decrease, and all women in the 5th and ≥6 attempt groups passed. However, it is plausible that there may have been women who did not continue attempting to pass the BPAT following an initial failure. Twenty-six women failed their first attempt at the BPAT, and there were only 12 women in the 2nd attempt group. To recruit and retain more women, the provision of job task practice and strength and conditioning programs could be offered to candidates to limit failure in the BPAT and similar physical ability tests. Indeed, some fire departments already offer specific training programs for women interested in the fire service.[39] The data from the current study provide some support for practice and familiarity for faster performance of the BPAT, and resources to encourage this for female candidates should be considered by fire departments.

There are study limitations that must be discussed. This study provided a cross-sectional analysis of BPAT performance. Because of the cross-sectional nature of this study and the de-identified dataset, it is possible that an individual candidate's data was present in more than one group. Additionally, the researchers could not link successive candidate attempts which made it challenging to directly measure the influence of prior attempts. Future research could conduct longitudinal analyses of candidates who fail prior attempts of the BPAT before passing and document any change scores that result from multiple BPAT attempts. The decrease in BPAT time over attempts could have been due to factors external to the additional practice that comes with completing more BPAT attempts, such as the training history of candidates. It is possible that candidates who failed an earlier attempt at the BPAT could have completed specific

strength and conditioning program,[25-27] or a community college training course,[12] prior to a successful BPAT attempt. Due to the use of stopwatch timing, there may have been user error with the recorded times.[40] However, this is standard practice in the BPAT and the times analyzed in this study were used for record for the candidates,[12] which provides validity to the measurements. Additionally, the length of the test should minimize any timing errors. The testing conditions could have varied across the candidates. However, for agencies and departments that conduct year-round testing, this limitation may be unavoidable and a necessary part of the process.[17] No fitness test data was available for the participants in the groups in this study. It is plausible that fitter candidates would require fewer attempts to pass the BPAT,[1-3,12] but that would need to be confirmed by future research.

To conclude, the results showed that completion time was significantly faster for candidates who had completed more attempts at the BPAT, with effects ranging from small to large. Further, the relative number of candidates who failed the BPAT was lower with more attempts. It should be noted that there could be candidates who did not return to attempt the BPAT after failing. However, for those that did, it is plausible that greater familiarization with the BPAT contributed to faster times, which were documented by significant differences and moderate-to-large effects. Although further research is needed, the results may indicate the potential benefits of practice and skill development to pass the BPAT. When considered in the context of previous research linking fitness and job-specific firefighting task performance, it is plausible that fitness training sessions could also help develop the overall capacity of the candidate that is needed to pass the BPAT as well. This could then translate to the requirements of academy training and future job performance. Considering the number of candidates who passed the BPAT on the first attempt, many candidates reporting for testing likely had the physicality and skill needed to complete the assessed job tasks. However, completion of firefighting skills practice and fitness training would be especially important for candidates lacking in certain characteristics that could benefit job task performance, including women. Completion of specific training to enhance BPAT performance could also assist in moving candidates into the employment pipeline sooner for fire departments.

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Corresponding author: Robert Lockie, PhD; rlockie@fullerton.edu