THE CrossFit JOURNAL

IWCABTAMD

Dr. Steven Platek and co. offer up data analysis showing increased performance in Fran, Angie, Cindy and the CrossFit Total.

By Dr. Steven M. Platek, J. Ryan Porter and Tia Y. Walters **March 2011**

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Constantly varied functional movements executed at high intensity—this is CrossFit.

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Creating functionally fit individuals is a primary goal of CrossFit, and an efficacious way of measuring or operationally defining fitness is in an athlete's ability to do more work faster and across variable domains over time—increased work capacity across broad time and modal domains, or "IWCABTAMD."

For those of us who are embedded in the culture and the workouts, there is little skepticism about this method because we have loads of anecdotal evidence to draw on. For example, we have one athlete at CrossFit Gwinnet who could not run more than about five steps at one point. About six weeks later, he ran 1.6 miles. After this accomplishment, he informed us the distance was the greatest he'd ever run.

Anecdotal evidence, however, is just that: anecdotal. In order to show the efficacy of any treatment program, one must devise an experiment where progress is tracked over time. Individuals outside the CrossFit community often question the metric for measuring the efficacy of CrossFit. For instance, they'll ask, "Where's the data?" We've seen posts like this quite a few times on CrossFit.com.

In an effort to demonstrate evidence-based increases in performance, we conducted two small-scale post-hoc studies. In Experiment 1, we analyzed main-site posts for a benchmark CrossFit workout: Fran. These initial data, even in light of the myriad scientific and methodological limitations associated with our approach, still revealed statistically significant increases in performance (decreased Fran times) over time.

In Experiment 2, we contacted Bill Patton, the owner of LogsItAll, an online repository for CrossFitters to log their times, loads and performance and keep track of their progress over time. Bill was kind enough to provide us with a nameless version of his database, from which we extracted data for four benchmark workouts: Fran, Angie, Cindy and the CrossFit Total. These data confirm the preliminary data from Experiment 1 with a larger sample size. In other words, people get quicker Fran and Angie times, complete more rounds of Cindy and lift heavier loads from doing CrossFit. Interestingly, this effect is not correlated with how frequently they encountered the WOD or their age!

Pilot Study: CrossFit.com Analysis of Fran

Methods

We perused the archives of the main-site blog and found six instances of Fran going back to September 2008. We then combed the blog for athletes who consistently posted a time for the workout. To do this, we compared blogs across dates to identify individuals who consistently reported times. In the end, we were only able to use three instances of Fran—September 2008, December 2008 and February 2009—because the number of athletes who posted across time points fell off quickly after February 2009. In fact, for the three instances after February 2009, we were only able to find 15 athletes who posted consistently. This, we felt, was too small a sample size to include in the analysis, and the period was therefore eliminated. After excluding the time points for which there was too small a sample size, we ended up with 45 athletes who posted for the three time periods that we included in our analysis.

For reasons of individual variability in posting strategy, almost all demographic information for the athletes was unavailable or unusable for analysis. For example, some athletes posted in a standardized fashion that included, age, sex, height, weight and the time it took to complete the workout, while others simply posted a time. Many posts do not bear on the workout at all, and those posts were not analyzed. However, the plethora of qualitative data in those posts is astounding and worthy of future research.

We ended up analyzing times on 45 athletes who posted on the September 2008, December 2008 and February 2009 instances Fran.

(We all know Fran is 21, 15, 9 reps of 95-lb. thrusters followed by pull-ups, for time. As a way of trying to make sense out of the variability in performance we noted the workout that preceded Fran. For the September Fran, the preceding workout was The Chief: max round in 3 minutes of 3 135-lb. power cleans, 6 push-ups and 9 squats. For the other two instances of Fran, December 2008 and February 2009, the preceding day was a rest day.)

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Analysis

In order to investigate whether there was an increase in Fran performance as measured by decreased Fran times across these three time points, we employed a three-way repeated-measures analysis of variance (rmANOVA). (The repeated measures ANOVA allows you to investigate changes in"'effect" in the same participants across time or treatment.) In order to standardize the units, we converted all times into seconds.

Results and Discussion

The analysis revealed that Fran times decreased in a statistically significant way over the three time points ($F(2,88) = 4.048$, $p < .05$; see Figure 1). The greatest extent of change was seen when directly comparing times posted for February 2009 with September and December 2008:

$M^{\text{difference (Sept. 08 – Feb. 09)}} = 44.33$, S.E.M. = 17.827, $p < .05$ (S.E.M. means "standard error of the mean")

$M^{\text{difference (Dec. 08 – Feb. 09)}} = 41.393$, S.E.M. = 15.486, $p < .05$

The difference between September and December 2008 was not significant:

$M^{\text{difference (Sept. 08 – Dec. 08)}} = 2.40$, S.E.M. = 19.073, $p > .05$

Analysis of Four Benchmark WODs

Methods

The data for this larger study were kindly provided by LogsItAll (LIA) in a fashion so that identity could not be determined. LIA has an enormous database of repeat posters that also includes demographic information such as sex and age. This allowed us to make sex comparisons as well as conduct the analyses on a much larger data set. One of the issues inherent in posting to websites, apparently, is attrition, and for that fact we used athletes' first four posts to LIA. The sample size of athletes who continued to post after their fourth post dropped precipitously, and even for those who post on four instances, females tend to do so less often.

We extracted the relevant data (time, number of rounds or weight) from the LIA database and utilized SPSS to analyze the data. All data were processed using a 2 (sex) X 4 (time point) repeated measures ANOVA. In some cases, we reduced the number of posts to the first three posts in order to help increase the female sample size; those data are not reported here but confirm the findings detailed here and are available upon request to Dr. Platek (see below).

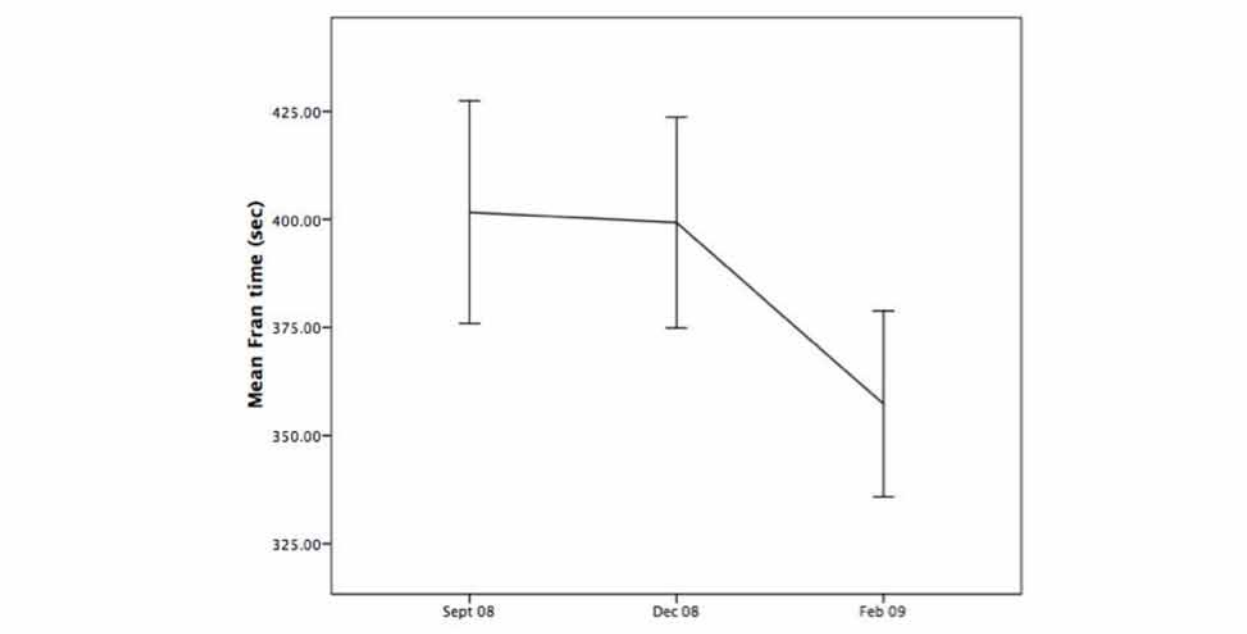

Figure 1: Mean (+/- S.E.M) decreasing Fran times over five months in 45 athletes who repeatedly posted to the CrossFit main-site blog. (S.E.M. means "standard error of the mean.")

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Fran Sample

A total of 232 athletes (206 males, M^{age} = 33.82; 26 females, M^{age} = 35.33) reported data for four time points of Fran. All data are reported in seconds.

Fran Results

When collapsing across all time points, there were no statistically significant differences between males (M = 434.35, S.E.M. = 11.55) and females (M = 450.42, S.E.M. = 32.53). There was, however, a significant effect for time ($F(3,690) = 19.25, p < 05$). Interestingly, there were significant decreases in Fran time for all time points except between time points two and three. There was no interaction between time point and sex of the athlete (Figure 2). Mean time between Fran occurrences and the mean performance increase between time points was also calculated. A correlation revealed no relationship between time occurrences of Fran and increases in performance (decreased time). There was also no correlation between age and increases in performance.

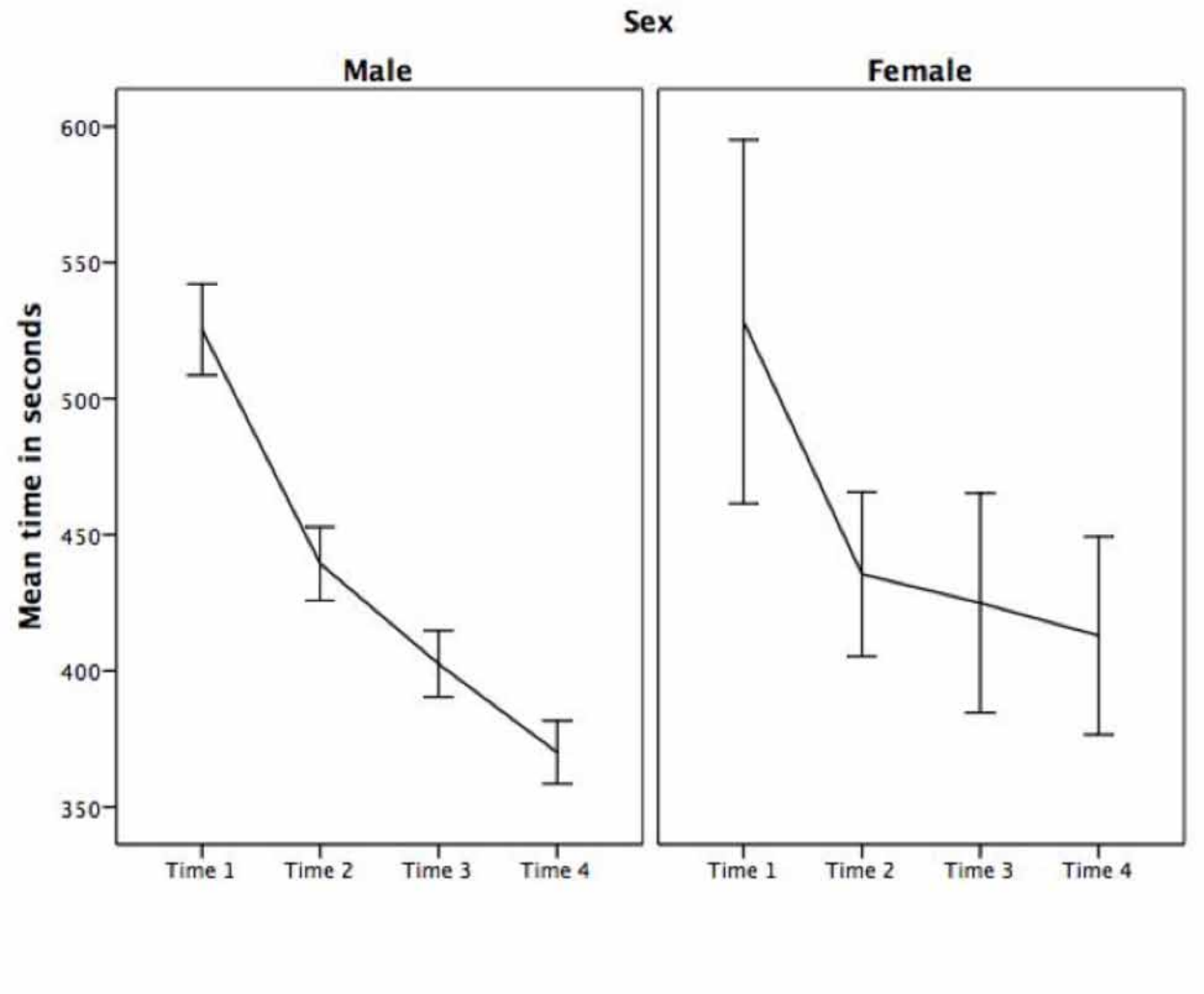

Figure 2: Mean (+/- S.E.M.) Fran times across our time points in 232 athletes. There was no overall difference between men and women.

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Angie Sample

The sample consisted of 102 athletes (90 males, $M^{age} = 34.7$, 12 females, $M^{age} = 35.77$) who completed four time points. All data are reported in seconds.

Angie Results

There was no difference in Angie time between males and females (this needs to be interpreted with caution because of the low sample size for women), but there was a non-statistically significant trend toward an effect for time point ($F(3,300) = 2.325$, $p = .075$). Post-hoc analysis did reveal that Time Point 1 was significantly slower when compared directly to Time Point 4 ($p < .05$). (Figure 3). There was no correlation between time of Angie occurrences and performance increases and also no correlation between performance increases and age.

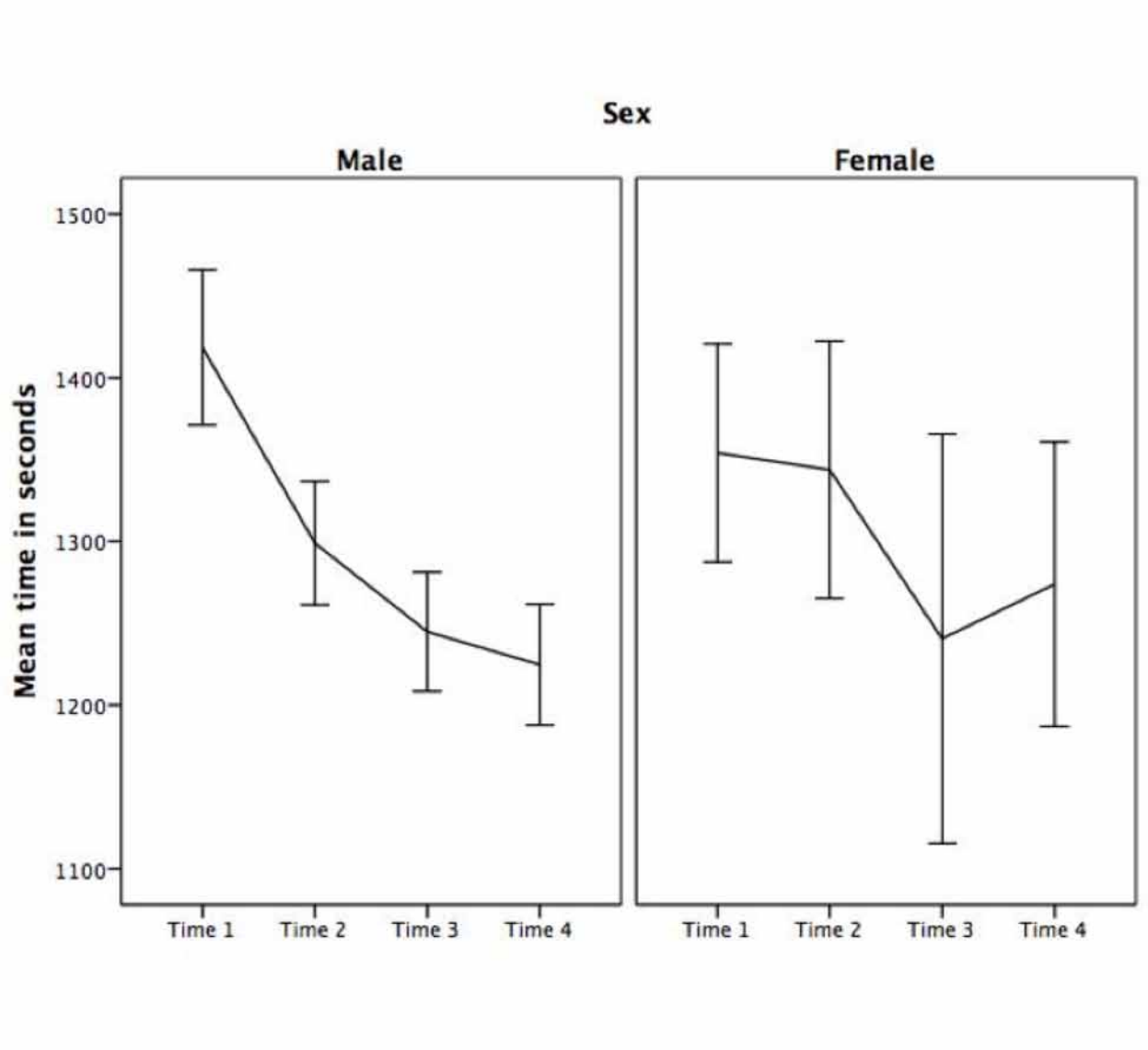

Figure 3: Mean (+/- S.E.M.) Angie times across four time points in 102 athletes.

Cindy Samples

The Cindy sample consisted of 101 athletes (89 males, M^{age} = 36.02; 12 females, M^{age} = 39.33).

Cindy Results

There was a significant difference in number of completed rounds of Cindy between males (M = 17.66, S.E.M. = 0.457) and females (M = 14.24, S.E.M. = 1.24) ($F(1,99) = 6.70$, $p < .05$) (again these data need to be interpreted with caution because of the low sample size for women). There was also an effect of time point ($F(3,297) = 2.67$, $p < .05$). There was no interaction between time point and sex. Post-hoc analyses revealed that more rounds of Cindy were completed at Time Point 4 when compared directly to time points 1 and 2 (Figure 4). For Cindy, there was also no correlation between age and performance increases and also no correlation between time between Cindy occurrences and performance increases.

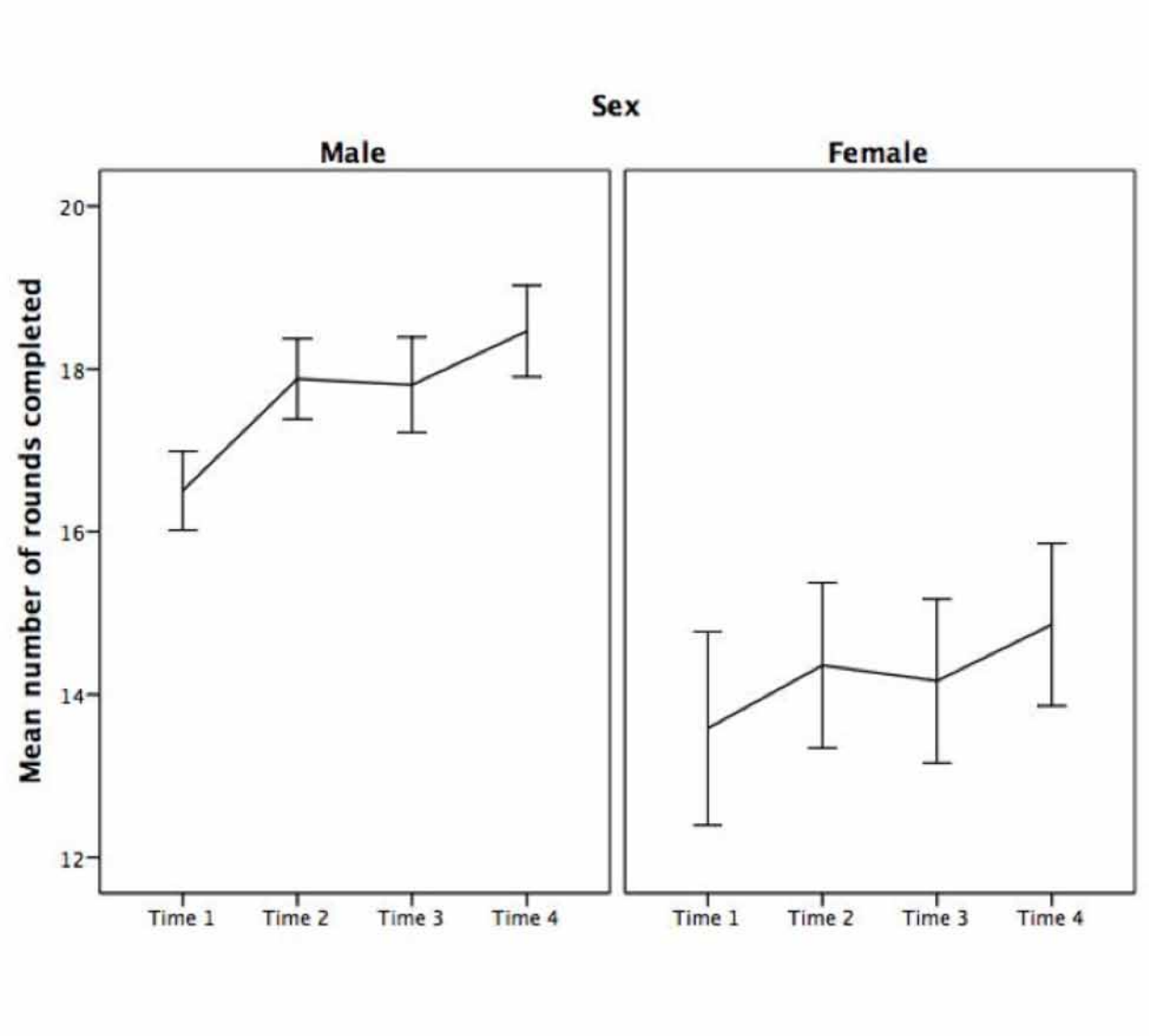

Figure 4: Increases in the number of Cindy rounds over four time points in 101 athletes.

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CrossFit Total Sample

Eighty athletes (72 males, M^{age} = 34.42; 8 females, M^{age} = 34.40) posted their CrossFit Total loads at four time points.

CrossFit Total Results

There was a large, as expected, sex difference (males M = 742.20, S.E.M. = 15.70; females M = 484.22, S.E.M. = 47.10). There was also a large effect for time point ($F(3,234) = 13.25$, $p < .001$). There was no interaction between time point and sex. Post-hoc analyses revealed that all loads were heavier after Time Point 1, but that there was no difference between time points two and three (Figure 5). There was also no correlation between age and performance increase and no correlation between performance increases and time between CrossFit Total occurrences.

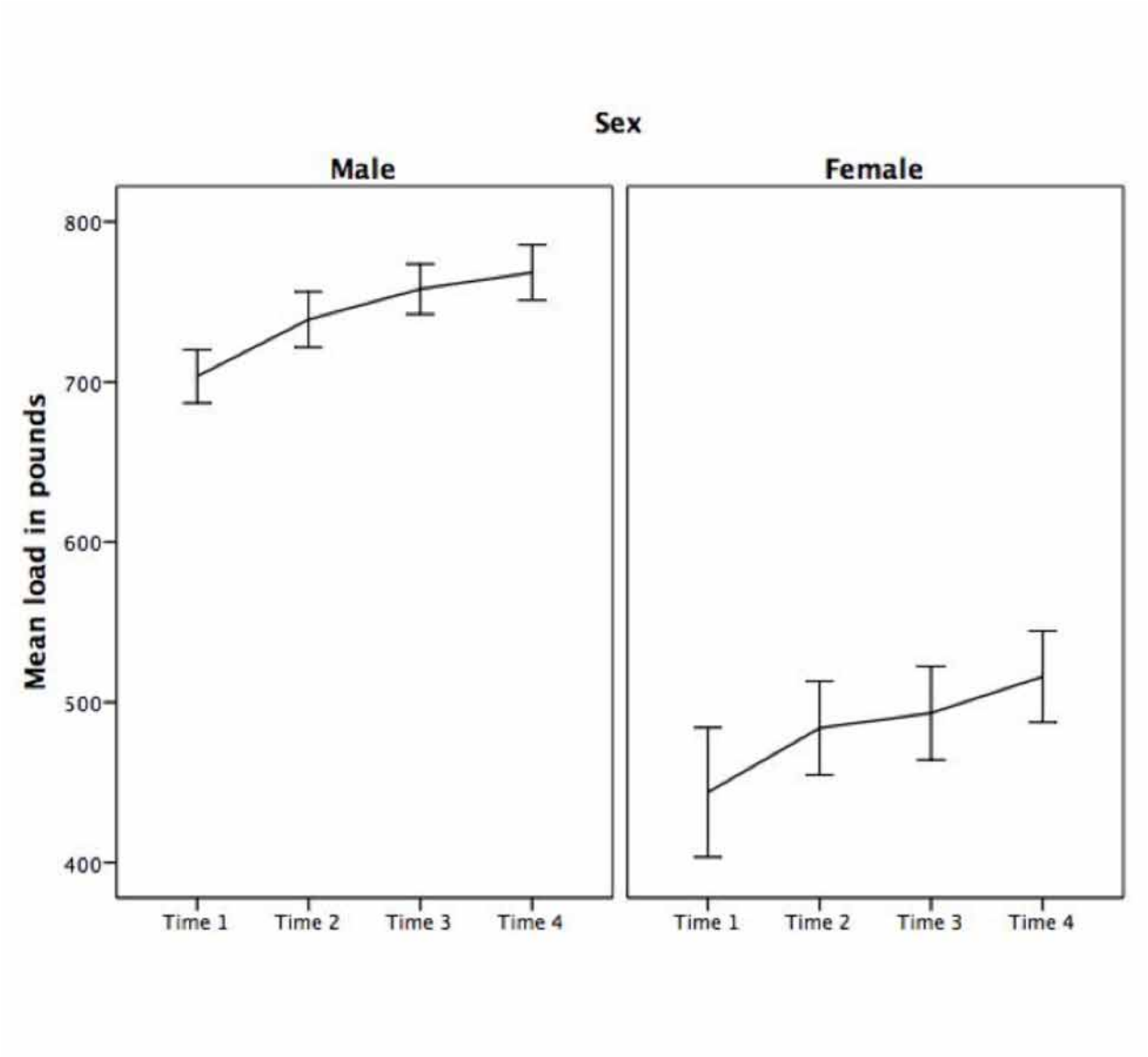

Figure 5: Mean (+/-S.E.M.) CrossFit Total loads of 80 athletes across four time points. Men posted significantly heavier loads than women, but both groups showed significant increases in loads over time.

Discussion

What do these data mean?

Well, if you've experienced a decrease in your Fran or Angie time, an increase in your number of rounds of Cindy, or an increase in your CrossFit Total load since starting CrossFit, these data will not be surprising.

But, if you reflect on the notion of evidence-based fitness, then these data are among the growing data-driven demonstrations of the effectiveness of the CrossFit training modality. That is, rather than use an N = 1 to N = 5-10 anecdotal sample size (yourself or a small sample of athletes at your box), here we've described the change in performance across time (that is, the change in work capacity across time in several benchmark WODs) in larger numbers of athletes.

These data are not without their problems. First, if you were to calculate the effect sizes for these findings, they are rather small, accounting for only 8-15 percent of the variance in WOD performance. That is, time, our experimental factor, accounts for only a small proportion of the variance in WOD performance. While these effects are small, they are also quite interesting: they suggest that time is simply one rather small factor that accounts for changes in performance. What accounts for the other X percent of variance probably includes factors such as pre-CrossFit fitness level, sex, age, nutrition and dedication to the WOD and main site. Also, neuroendocrinological changes such as upregulation of the hypothalamic-pituitary-adrenal (HPA) and hypothalamic-pituitary-gonadal (HPG) axes are likely to play an active and substantial role, although further investigation on this hypothesis is necessary and underway in our laboratory.

Additional limitations include the methods used in this investigation. In both experiments, we had no scientific control over these athletes. We were not able to track their nutrition, modify and correct their movement patterns, or observe the environment in which a WOD was executed (e.g., Globo Gym vs. box vs. garage). We also have to rely on the honesty of the athletes' reporting. It's possible that some athletes might have posted false times in an attempt to appear fitter (the self-serving attribution bias). Some of the individuals who posted might have been non-CrossFitters posting bogus times.

However, even in light of the multitude of methodological issues, the possibility for error around the means, and limitations, we still found a statistically significant change in performance over time.

Furthermore, in Experiment 2, it's very important to note that for every benchmark WOD we analyzed, the average time between WOD and age did not correlate with increases in performance. This finding alone is interesting in that it demonstrates that CrossFit works independent of age and regardless of practice of the specific WOD movements and combinations. Similarly, only one of the benchmark WODs (CrossFit Total) revealed a large sex difference, supporting the idea that CrossFit works independent of sex.

It's important to restate this finding: These data taken together strongly suggest that, with the exception of strength bias in our sample, CrossFit increases work capacity across broad time and modal domains independent of sex, age and frequency of exposure to the WOD.

As mentioned earlier, the effect sizes for these effects are small to modest. We feel strongly that more variance could be accounted for if nutritional data were available. Therefore, we'd like to collaborate with any affiliates running nutrition (Paleo or Zone) challenges to amass a much larger database that takes into account the effects of nutrition on performance. We've heard several anecdotes and seen some preliminary, small sample size (n = 1-8) data showing synergistic effects of nutrition and performance.

We are currently starting several controlled research studies related to these ideas at CrossFit Gwinnett. The aim is to take this preliminary data that is wrought with low scientific control and tease apart the effects that are driving increased performance in our athletes. We are inviting the CrossFit affiliate community to join us and facilitate a larger and more controlled data set. We are aware that many boxes, affiliates and trainers have run or are running nutrition challenges where athletes are enrolled in a nutritional program for four, six or eight weeks. We have also done one at CrossFit Gwinnet.

Prior to these challenges, athletes are usually run through a number of benchmark WODs, and morphological measurements (weight, waist, body-fat percentage, etc.) and photographs are taken. These same metrics are then

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used at the completion of the challenge in order to track and demonstrate progress. If any affiliates have data such as those described above and would be willing to share the data with us, we will create an improved database for demonstration of the synergistic effects of nutrition and fitness in a greater number of athletes. Interested affiliates can e-mail data or contact Dr. Platek at steve@crossfit-gwinnett.com for more information.

Acknowledgements: Thanks to Bill Patton for generously providing an anonymized dataset from LogsItAll and for comments on an earlier version of this manuscript.

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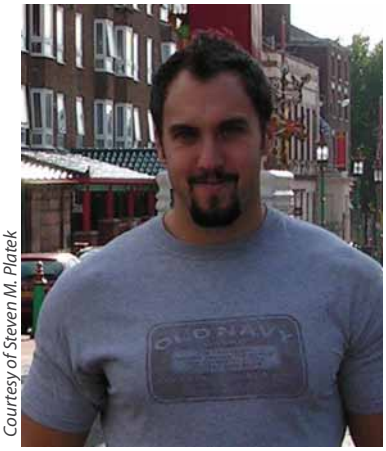
About the Authors



Courtesy of Steven M. Platek

Steven M. Platek (Ph.D. biological psychology, University at Albany—SUNY) is associate professor of psychology in the School of Liberal Arts at Georgia Gwinnett College, associate researcher at the MARIARC imaging center of the University of Liverpool, and collaborator at the Center for Advanced Brain Imaging. Platek is director of the Evolutionary Cognitive Neuroscience Laboratory (ECNL), where he and his students have identified the unique neural substrates associated with self-referent phenotype matching (facial resemblance), self-face recognition, kin recognition, and attractiveness of female body morphology and male facial characteristics. He has published over 60 scholarly peer-reviewed articles, edited three academic volumes, is editor-in-chief of the journal ***Frontiers in Evolutionary Neuroscience****, co-editor-in-chief and managing editor of the journal* ***Evolutionary Psychology****, associate editor of the journal* ***Personality and Individual Differences****, and consulting editor for the journal* ***Human Nature****. He also serves on the editorial boards of the* ***Journal of Social, Cultural and Evolutionary Psychology****; the* ***Open Ecology Journal****;* ***Scientific Research and Essays****; the* ***Open Neuroimaging Journal****; the* ***Open Evolution Journal****; and the* ***Journal of Scientific Psychology****. A new focus for Platek and his team is to study the neurocognitive and psychological effects of various fitness-training regimens, particularly functional fitness vs. non-functional fitness movements and the benefits of ancestral living strategies. He is a Level 1 CrossFit trainer and director/owner of CrossFit Gwinnett. His wife, Austen, is also an avid CrossFitter, and the couple had their first child in the fall of 2010.*

Courtesy of J. Ryan Porter

J. Ryan Porter is an undergraduate psychology student at Georgia Gwinnett College and a member of CrossFit Gwinnett. Ryan is Level 1 trainer and co-coaches at CrossFit Gwinnett.

Courtesy of Tia Y. Walters

Tia Y. Walters is an undergraduate psychology student at Georgia Gwinnett College and a member of CrossFit Gwinnett. Tia has presented scientific papers on the topic of waist-to-hip ratio and is currently researching female intrasexual competition as it relates to body morphology and strength. Tia is also a Level 1 trainer and a co-coach at CrossFit Gwinnett

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