



A Case Study Comparison of Two Carbon-Plated Running Shoes on Running Economy and Running Mechanics

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Abstract

The advent of the carbon-plated running shoe, in support of the first, historic sub 2-hour marathon, has resulted in an arms race across various running shoe companies in hopes of providing a similar competitive advantage to their athletes and customers. Research has shown these new shoe technologies can significantly improve running economy. However, of the limited research, most is focused on just one brand and model of carbon-plated shoe. If athletes are to compete on a level playing field, further investigation is needed to determine that these new shoe technologies confer a similar competitive advantage across multiple brands and models. **PURPOSE:** Case study comparison on the effects of two carbon-plated running shoes (Hoka CarbonX vs. Nike Zoom Alphafly Next%) and a traditional running/racing shoe (Hoka Tracer 2) on running economy and running mechanics. **METHODS:** Data was collected on one male distance runner (age: 35 years, height: 178 cm, weight: 67.7 kg) on two separate days. On the first testing day, the Tracer 2 (TR) was compared to the Carbon X (CX). On the second testing day, the CX was compared to the Alphafly (AF). Following a 10-minute jog, a series of 4 x 6 minute trials (two trials per shoe, randomized) were completed at 13.84 km/hr (~7:00/mile pace) and at 15.29 km/hr (~6:20/mile pace) with a 4-minute break between trials. Oxygen consumption (VO₂) was recorded continuously throughout each trial and the final 3 minutes were averaged. Further, the two trials in a given shoe at a given speed were averaged to make comparisons between shoes. Similarly, heart rate (HR), ground contact time (GCT), cadence, and vertical oscillation (VO) were measured (Garmin, HRM-Tri). **RESULTS:** On day 1, comparisons (mean ± SD, % difference) of the TR to CX at 13.84 km/hr were as follows: VO₂ (ml/kg/min; TR: 46.9 ± 0.2, CX: 46.8 ± 0.6, -0.3%), HR (bpm; TR: 170 ± 0, CX: 169 ± 3, -0.7%), GCT (ms; TR: 201 ± 0.1, CX: 203 ± 1.8, 0.7%), Cadence (steps/minute; TR: 171 ± 0.8, CX: 172 ± 0.1, 0.3%), VO (cm; TR: 11.3 ± 0.2, CX: 11.2 ± 0.1, -1%) and at 15.29 km/hr: VO₂ (TR: 51.3 ± 0.1, CX: 51.2 ± 0.1, -0.1%), HR (TR: 179 ± 0.9, CX: 179 ± 1.9, 0%), GCT (TR: 195 ± 1.1, CX: 193 ± 0.5, -1.2%), Cadence (TR: 173 ± 0.4, CX: 172 ± 0.7, -0.3%), VO (TR: 10.8 ± 0, CX: 11 ± 0.2, 2%). On day 2, comparisons of the CX to AF at 13.84 km/hr were as follows: VO₂ (CX: 45.7 ± 0, AF: 43.9 ± 0.2, -3.8%), HR (CX: 170 ± 0.6, AF: 168 ± 1.9, -1.3%), GCT (CX: 202 ± 0.2, AF: 205 ± 1, 1.3%), Cadence (CX: 173 ± 0.6, AF: 169 ± 0.1, -2.3%), VO (CX: 10.4 ± 0.1, AF: 11.0 ± 0.1, 5.7%) and at 15.29 km/hr: VO₂ (CX: 50.8 ± 0.4, AF: 48.7 ± 0.1, -4.2%), HR (CX: 179 ± 0.2, AF: 177 ± 1.8, -0.9%), GCT (CX: 193 ± 0.2, AF: 197 ± 0.4, 1.7%), Cadence (CX: 175 ± 0.7, AF: 171 ± 1.8, -2.3%), VO (CX: 10.4 ± 0.1, AF: 11.1 ± 0.4, 6%). **CONCLUSION:** Compared to the TR, the CX did not result in meaningful differences in economy or mechanics in this case study. However, the AF improved economy by ~4% compared to the CX, while increasing vertical oscillation (6%) and decreasing cadence (2.3%). While statistical inferences cannot be made from this case study analysis, these findings do raise concerns on the relative advantages offered by new shoe technologies across different brands and models of shoes.

Introduction

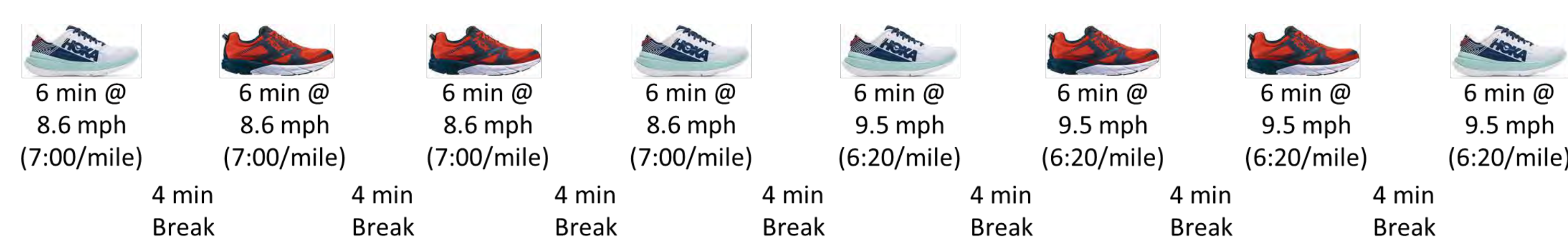
- Advancements in competitive running shoes, particularly the development of new midsole foams and the use of carbon-fiber plates, are thought to be contributing to widespread performance improvements, including the first, historic sub 2-hour marathon.
- Published research has shown that these new shoes can significantly improve running economy, a key marker of performance.
- However, of the limited research, most is focused on a single company/shoe line (Nike Vaporfly/Alphafly).
- While other brands have now brought their own versions of these new “super” shoes to market, without independent testing and published research, it is unclear if the playing field is truly level at this point, which should be a serious concern among coaches, athletes, sport fans, and sport governing bodies.
- Therefore, the purpose of this pilot study was to serve as a case study comparison on the effects of two carbon-plated running shoes (Hoka CarbonX vs. Nike Zoom Alphafly Next%) and a traditional running/racing shoe (Hoka Tracer 2) on running economy and running mechanics.

Methods

- Data was collected one male distance runner (age: 35 years, height: 178 cm, weight: 67.7 kg, velocity @ lactate threshold: ~6:00/mile).
- Testing occurred on two separate days with approximately 1 week between sessions.
- Session 1 compared the Hoka Tracer 2 (non-carbon plated) to the Hoka Carbon X.
- Session 2 compared the Hoka Carbon X to the Nike Zoom Alphafly Next%.
- Info on the different shoe specifications is provided in table below.
- All sessions began with a 10-minute jog (slower than 7:00/mile) in the subject’s normal training shoe, followed by a 10-minute break before beginning the actual test sessions.
- For each test session, a series of 4 x 6-minute trials (two trials per shoe, randomized) were completed at 8.6 mph (~7:00/mile) and at 9.5 mph (~6:20/mile).
- There was a 4-minute break between trials.

- The two shoes were worn in an A-B-B-A sequence over the 4 trials at a given speed.

Session 1 Protocol:



Session 2 Protocol:



	Shoe	Weight	Carbon Plate	Heel Height	Toe Height	Heel-Toe Drop	Shoe Mileage
	Hoka Tracer 2	8.2 oz (232 grams)	No	22 mm	18 mm	4 mm	~50 miles
	Hoka Carbon X	8.8 oz (249 grams)	Yes	35 mm	30 mm	5 mm	~150 miles
	Nike Zoom Alphafly Next%	8.3 oz (235 grams)	Yes	40	36	4 mm	~20 miles

- VO₂ (ParvoMedics) was measured continuously throughout each 6-minute trial and the final 3 minutes of data was averaged. Further, the averages between both trials at a given speed for each shoe was determined to make shoe to shoe comparisons.
- Heart rate and running mechanics (Garmin, HRM-Tri) were measured continuously throughout each 6-minute trial. Heart rate was averaged over the final minute and running mechanics from 30-seconds to 6-minutes.

Results

Tracer 2 vs Carbon X

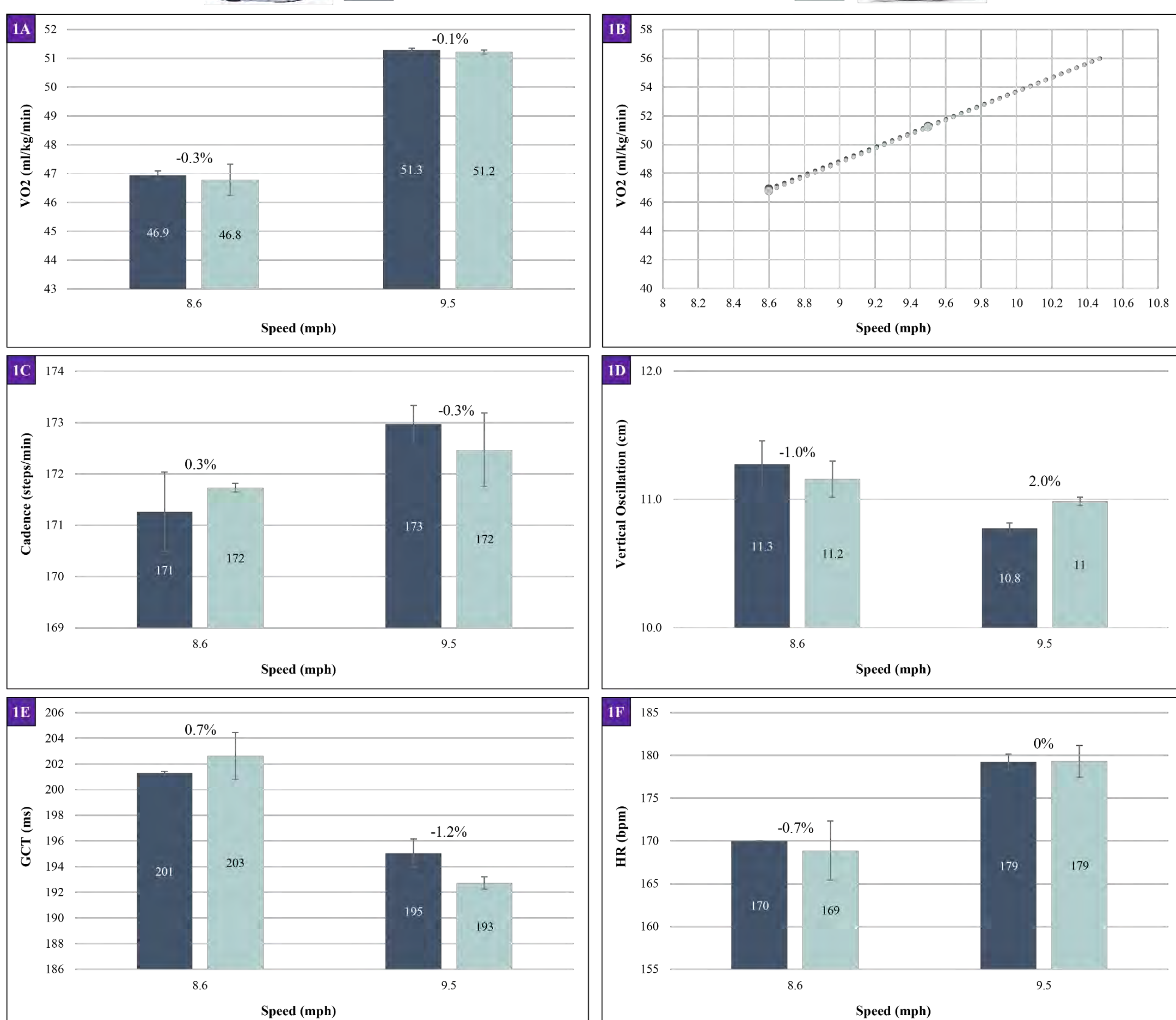


FIGURE 1. Case study comparison (n = 1) of running economy and running mechanics at two different running speeds (8.6 and 9.5 mph) in two different running shoes (Hoka Tracer 2 and Hoka Carbon X) on testing session 1. Values represent mean ± SD from 2 trials per condition with percent difference between shoes also displayed.

Carbon X vs Alphafly

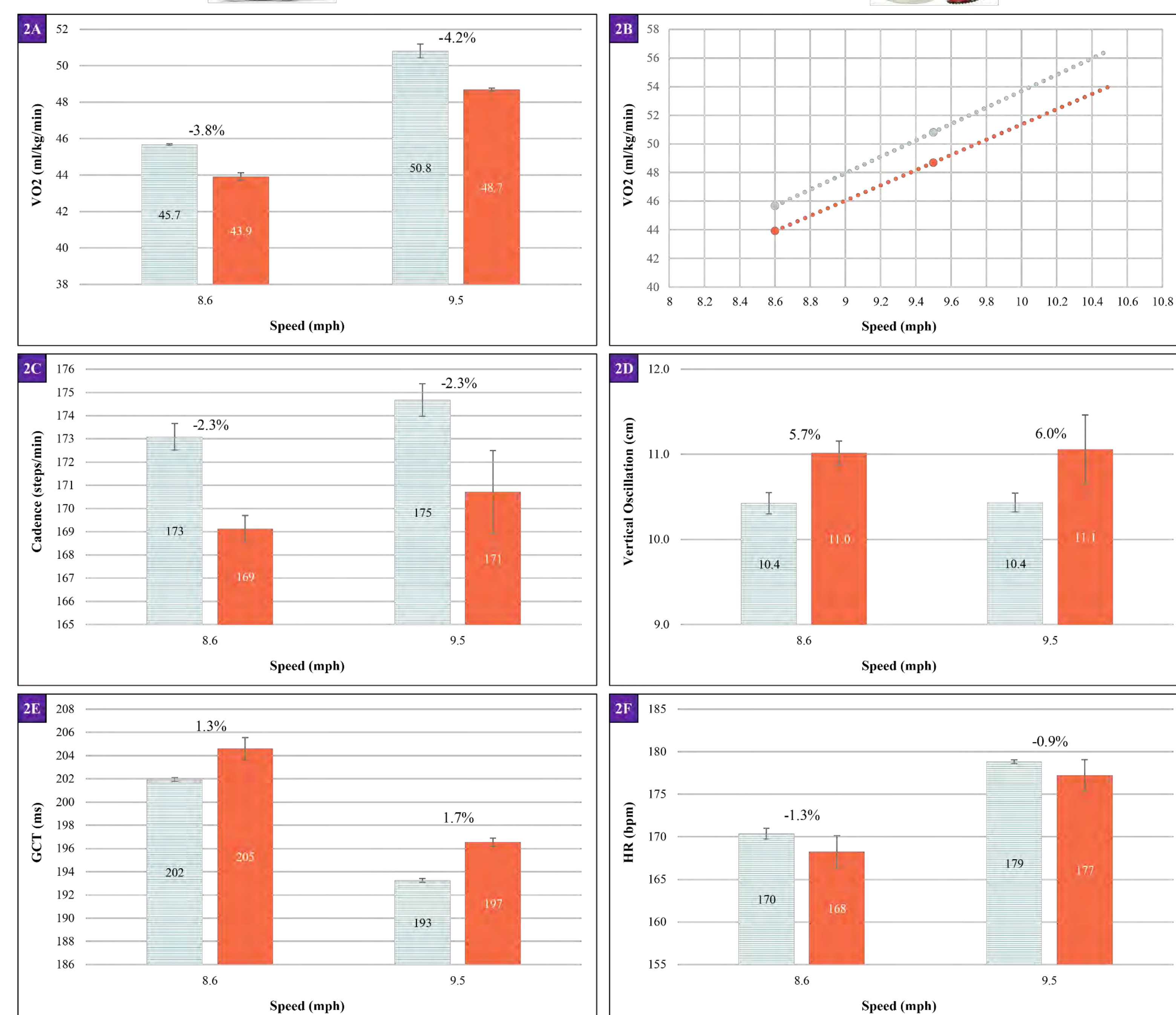


FIGURE 2. Case study comparison (n = 1) of running economy and running mechanics at two different running speeds (8.6 and 9.5 mph) in two different running shoes (Hoka Carbon X and Nike Alphafly) on testing session 2. Values represent mean ± SD from 2 trials per condition with percent difference between shoes also displayed.

Conclusions

- Compared to the Hoka Tracer 2, the Hoka Carbon X did not result in meaningful differences in economy or mechanics in this case study.
- However, the Nike Zoom Alphafly Next% improved economy by 4% compared to the Hoka Carbon X. These improvements in economy occurred with altered mechanics, 6% ↑ vertical oscillation and 2.3% ↓ cadence, that might traditionally be considered unfavorable.
- While statistical inferences cannot be made from this case study analysis, these findings do raise concerns on the relative advantages offered by new shoe technologies across different brands and models of shoes.