

Completing an endurance season: a comparison of adaptive training systems

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Abstract

Endurance athletes rarely fail because a season plan contains no workouts; they fail because a static prescription cannot absorb missed sessions, work demands, illness, changing readiness and the approach of a goal race. We define a *season completer* as a system that carries an athlete from the start of a training cycle to its target while deciding what should happen next when reality diverges from the plan. Six archetypes were compared in one paired 84-day synthetic experiment: self-directed auto-training, a generic goal plan, a static coach-authored plan, coach-assisted review every 15 days, SportPlan Free and SportPlan Pro. Across 9,996 matched profiles per policy, mean modeled event-performance gain was 2.567 for auto-training, 2.803 for coach-assisted review, 2.868 for SportPlan Free and 2.917 for SportPlan Pro. Free and Pro exceeded every modeled non-SportPlan alternative; Pro was 13.6% above auto-training, 4.1% above coach-assisted review and 1.7% above Free. Free and Pro also had the two highest terminal-adaptation means. The corresponding race-readiness index, with coach-assisted review set to 100, was 102.3 for Free and 104.1 for Pro. These results demonstrate internal model behavior, not real-athlete efficacy; injury burden was non-monotonic.

Season completion is a systems problem

Training response is heterogeneous: the same programme can produce large gains in one athlete and little change in another.^{1,2} No intensity distribution is universally best across sports, levels and study designs,^{3,4} and consensus guidance favours combining external load with internal measures rather than treating one signal as truth.^{5,6,7} The acute:chronic workload ratio has important conceptual limits and did not reduce health problems in a randomized implementation trial,^{8,9} whereas heart-rate-variability-guided prescription shows small, uncertain average advantages.¹⁰ Taper evidence is clearer about direction than exact dose: volume usually falls while intensity and frequency are protected.^{11,12} Concurrent strength training can improve determinants of endurance performance,^{13,14} but the practical problem remains integration across an imperfect season.

Life stress and major life events reduce exercise participation, and lack of support predicts discontinuation.^{15,16,17,18} A season-completion system must therefore do more than generate a good opening plan. It must preserve the goal, revise the route, distinguish missing data from poor readiness, avoid catching up missed load, and know when a race-specific decision is required.

Key points

- A season completer is defined by how it manages divergence from the plan, not by how many workouts it can generate.
- The six modeled policies form an information ladder: self-directed auto-training, generic plan, static coach plan, coach-assisted review, SportPlan Free and SportPlan Pro.
- SportPlan Free contains continuous readiness, health, adherence and life-fit adaptation; SportPlan Pro adds race-specific preparation, taper and race-week logic.
- Free and Pro led primary event performance and terminal adaptation; coach-assisted review led the modeled non-SportPlan policies.
- Race readiness expresses the integrated event-performance result relative to coach-assisted review = 100; it is not an independent endpoint.

The season completers

The comparison uses six archetypes rather than named competing products. Together they span common ways an endurance athlete attempts to complete a season, but they are not an exhaustive market census. The self-directed arm is a deliberately uninformed negative control, not a claim about knowledgeable self-coached athletes. The coach-assisted arm represents a 15-day review cadence, not the full capability of an attentive human coach.

Table 1 | Information and action available to each season-completion policy

Policy	Season structure	Individualized at start	Continuous response	Life-fit	Race-specific preparation
A · Self-directed auto-training	No	No	Short-memory daily choice	No	No
B · Generic goal plan	Yes	Broad goal band only	No	No	Generic taper
C · Static coach-authored plan	Yes	Yes	No	Opening availability only	Yes, frozen
D · Coach-assisted review	Yes	Yes	Every 15 days	Communicated conflicts	Yes, reviewed
E · SportPlan Free	Yes	Yes	Daily	Yes	No race input
F · SportPlan Pro	Yes	Yes	Daily	Yes	Yes

Free and Pro share the complete non-race adaptive core. Both can respond to readiness, active health constraints, adherence and declared work or availability limits. Pro receives no privileged physiology, adherence, execution or safety coefficient. Its only modeled addition is race context: event-specific preparation, a volume-led taper and race-week protection. Without race input, Free and Pro are the same policy.

A paired synthetic experiment

The experiment followed simulation-reporting and model-transparency principles.^{19,20} Four preset sport, experience and event strata each contributed 2,499 synthetic athletes, giving 9,996 athletes evaluated under every policy. Every athlete experienced the same

84-day horizon, five-hour weekly opportunity ceiling, starting state, latent traits, availability, life disruption, illness exposure and named random inputs across A-F. Each policy proposed sessions through its declared information boundary; one policy-blind world translated delivered training into adaptation, fatigue, health restrictions and event performance.

The primary engineering outcome was modeled event-performance gain relative to the same athlete following a matched no-training trajectory. All assigned profiles contributed to every policy mean, and the physiological model used no policy-specific outcome coefficient. Policy definitions had been refined during development before this reported run, with life-fit assigned to both Free and Pro before outcomes were generated; the experiment is therefore exploratory rather than independent confirmation.

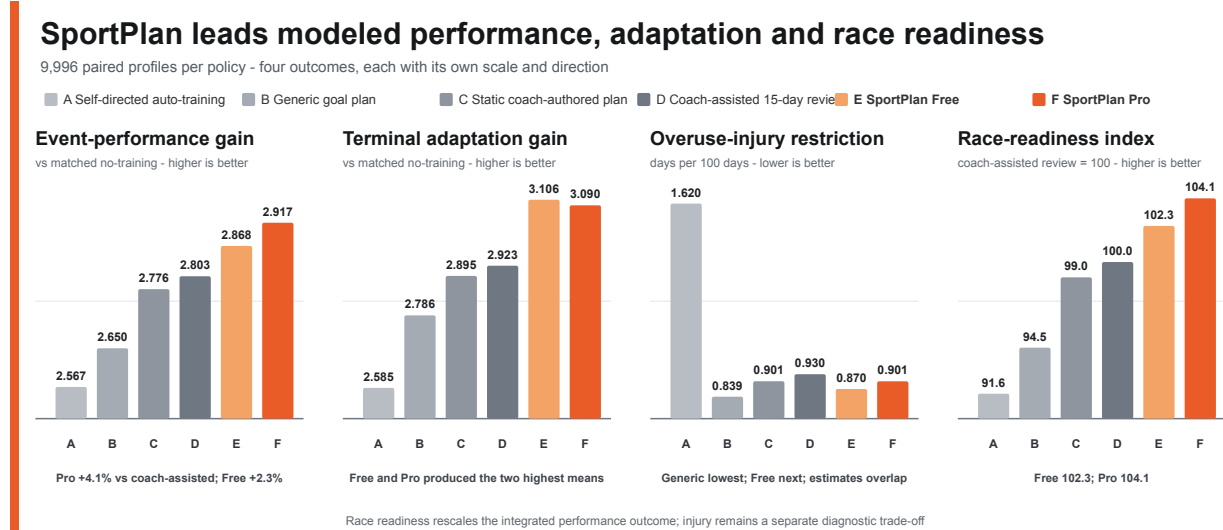


Figure 1 | Benchmark comparison across performance, adaptation, injury burden and race readiness. Full-population means across 9,996 paired profiles per policy. SportPlan Free and Pro had the two highest means for event-performance and terminal adaptation. The race-readiness panel rescales the integrated event-performance outcome to coach-assisted review = 100; it is not an independent outcome. Overuse-injury restriction remains a separate diagnostic with a lower-is-better direction. Each panel uses its own scale; values are synthetic and are not real-world treatment effects.

Primary result

Mean modeled event-performance gain increased from 2.567 for auto-training to 2.650 for the generic plan, 2.776 for the static coach plan, 2.803 for coach-assisted review, 2.868 for SportPlan Free and 2.917 for SportPlan Pro. Auto-training had the lowest mean, coach-assisted review had the highest mean among the modeled non-SportPlan policies, and Free and Pro occupied the two highest positions.

Within this synthetic world, Pro's mean gain was 13.6% larger than auto-training, 10.1% larger than the generic plan, 5.1% larger than the static coach plan, 4.1% larger than coach-assisted review and 1.7% larger than Free. Free was 2.3% above coach-assisted review. The defensible conclusion is narrow but direct: **SportPlan Free and Pro outperformed every modeled non-SportPlan season completer on the primary synthetic event-performance outcome.** These are modeled ratios, not treatment effects.

Table 2 | Primary outcome and diagnostic measures

Policy	Event-performance gain	Terminal adaptation gain	Race-readiness index	Completed hours	Overuse days per 100 calendar days
Auto-training	2.567	2.585	91.6	43.0	1.620
Generic plan	2.650	2.786	94.5	46.6	0.839
Static coach plan	2.776	2.895	99.0	48.7	0.901
Coach-assisted review	2.803	2.923	100.0	48.3	0.930
SportPlan Free	2.868	3.106	102.3	50.1	0.870
SportPlan Pro	2.917	3.090	104.1	48.1	0.901

The race-readiness index is event-performance gain divided by the coach-assisted mean and multiplied by 100. It provides an intuitive benchmark view of the primary outcome and is not an additional independent result.

Interpreting secondary outcomes

Event performance is an integrated outcome; accumulated adaptation and residual fatigue can move in opposite directions. An athlete who trains too little can carry little fatigue while remaining under-prepared. A well-executed taper intentionally reduces recent dose,

so Pro can finish with slightly less terminal adaptation than Free while expressing more of that fitness on race day. A policy that schedules fewer hours can also accumulate fewer exposure-related health events without being the better season strategy. Illness was identical across policies because it was paired and exogenous.

Auto-training had the lowest mean for the primary outcome and terminal adaptation, but not for training-time efficiency or overuse burden. Free produced the highest terminal adaptation, while Pro produced the highest integrated event performance and therefore the highest race-readiness index. Acute-injury and overuse means

