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FROM CONSTITUTION TO ADAPTIVE PROFILE: REPOSITIONING THE HEATH–CARTER SOMATOTYPE WITHIN AN INTEGRATIVE MODEL OF PHYSICAL AND PSYCHOLOGICAL ADAPTATION

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ABOUT ARTICLE

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Abstract: Athletes exposed to the same external training stimulus adapt at different rates and to different degrees. Anthropometric somatotyping is widely used to describe the morphological dimension of this variability, but in applied practice the somatotype is still frequently read as a predictor of athletic potential rather than as one descriptor among several. This conceptual review reconstructs the scientific lineage through which the somatotype acquired its present meaning, and proposes a framework in which it is treated as one component of an integrative adaptive profile rather than as a standalone selection criterion. A narrative, non-systematic review of primary and secondary sources was conducted across four domains: classical and medieval constitutional medicine; twentieth-century constitutional typology; kinanthropometric somatotyping; and the physiology of stress and adaptation. Sources were analysed thematically to identify the question each tradition addressed and the level of analysis at which it operated. Six historical stages are distinguished, from Hippocratic constitutional reasoning to Selye's general adaptation syndrome. On this basis an eight-level cyclical model is proposed,

in which intention and the anticipated result precede the motor act, and in which morphological, functional and psychological variables act as modulators between external load and internal response rather than as determinants of outcome. Within the model, the Heath–Carter somatotype occupies the morphological modulator position. The framework is theoretical and has not yet been tested empirically. Its practical value is expected to lie in multistage talent identification, individualisation of training load, adapted physical activity and Para sport, where a standardised external load produces markedly heterogeneous internal responses.

Introduction. Two athletes of similar age and training history can complete an identical session and finish it in very different physiological states. One recovers overnight; the other still shows elevated resting heart rate and depressed performance three days later. This asymmetry between a standardised external stimulus and a highly individual internal response is among the oldest problems in the study of the human body, and it remains unresolved in applied sport science.

The problem long predates modern physiology. Hippocratic medicine already held that environment and regimen do not act uniformly on every patient, because individuals differ in constitution [1]. Galen elaborated this into a system in which bodily mixture and behavioural disposition were treated as aspects of a single organisation [2], and it was largely through Ibn Sina's Canon of Medicine that this framework reached the medieval and early modern European tradition [3]. In the twentieth century, Kretschmer attempted to place physique and temperament within one empirical scheme [4], Sheldon introduced the term somatotype and the three-component description of physique [5], and Heath and Carter converted that description into a measurement procedure with defined protocols and open rating criteria [6–8]. In parallel, and in a different scientific domain, Selye reformulated the organism's response to demand as a generalised physiological syndrome with an identifiable temporal course [9–11].

These traditions are not commensurable, and treating them as a single continuous doctrine would be a historical error. What they share is a question rather than a method: why do individuals respond differently to comparable demands? Each stage answered that question at the level of analysis available to it — humoral, typological, morphometric, endocrine.

Contemporary practice has inherited the answers unevenly. The Heath–Carter method is well standardised and widely applied [12,13], yet in selection contexts a somatotype rating is still often used as if it carried predictive weight on its own. The problem is not the method but the inferential step attached to it: a description of body shape at one moment is treated as a statement about future adaptive capacity. Somatotype is not fixed. It shifts with growth, maturation, training history, nutritional status and inactivity [14], which is precisely why a single rating cannot function as a forecast.

A second gap concerns the entry point of the adaptive sequence. Physiological models of training adaptation conventionally begin with the stimulus. In practice, the athlete's own intention, and the result they anticipate, precede and shape the motor act — a point developed in the physiology of activity by Bernstein [15] and formalised by Anokhin in the concept of the action acceptor, the neural model of the expected outcome against which the achieved result is compared [16]. If that anticipatory stage is omitted, the model describes the organism as a recipient of load rather than as an agent producing it.

The aim of this review is therefore twofold: (i) to reconstruct the lineage through which the somatotype acquired its present meaning, distinguishing the level of analysis proper to each stage; and (ii) to propose an integrative framework in which morphological, functional and psychological variables act as modulators between external load and internal response. The intended contribution is conceptual clarification and a testable structure, not a new classification of physique.

Methods. Design

This is a narrative, non-systematic conceptual review. The design was chosen because the research question is definitional and structural rather than effect-related: it concerns how constructs from separate scientific traditions can be related to one another, which is not answerable by pooling effect sizes. No systematic search protocol was registered, and no meta-analytic procedure was applied. This is a limitation of the design and is addressed in Section 4.4.

Identification of sources

Sources were identified in four domains. For the classical and medieval material, primary texts in modern critical translation were used together with secondary historical scholarship, since direct interpretation of ancient medical texts falls outside the author's competence. For constitutional typology and kinanthropometry, the original methodological papers were used rather than later summaries, because the successive modifications of the somatotype method are the object of analysis here. For stress physiology, Selye's own

publications were used together with the subsequent debate on their applicability to training [17–20]. For contemporary load theory, current position and consensus literature was used [21].

Searches were run in PubMed, Scopus and Google Scholar with combinations of the terms *somatotype*, *kinanthropometry*, *Heath–Carter*, *constitution*, *general adaptation syndrome*, *training load* and *talent identification*, without date restriction. Reference lists of retrieved items were screened for further sources.

2.3 Analytical procedure

Each source was characterised on three dimensions: the question it addressed, the level of analysis at which it operated, and the type of evidence it offered. Sources were then grouped into historical stages, and the stages arranged by level of analysis rather than by chronology alone. The proposed model was constructed by identifying the points at which one stage leaves a variable unspecified that a later stage measures. No claim of empirical validation is made for the resulting structure.

Results. From qualitative constitution to quantitative morphology

The Hippocratic and Galenic inheritance

The Hippocratic writings do not describe the body through standardised measurement, and it would be anachronistic to read them as proto-anthropometry. Their methodological significance lies elsewhere. They establish that regimen and environment are mediated by the individual constitution, so that identical external conditions do not entail identical outcomes [1]. Stated in current terms, the external stimulus and the internal response are distinct constructs — the same distinction that underlies the modern separation of external and internal training load [21].

Galen systematised this reasoning by linking bodily mixture to behavioural disposition [2]. The humoral physiology on which he relied has no standing as an explanatory model today. What survives is the structural commitment: that morphology and behaviour are dimensions of one organisation and should be studied together. Ibn Sina's transmission of this framework matters here for more than bibliographic reasons; the Canon organised temperament as a graded, individually variable property rather than as membership in a fixed class [3], and it is that graded reading, not the categorical one, that the quantitative methods eventually recovered.

Kretschmer and the limits of typology

Kretschmer's contribution was to submit the physique–temperament relationship to systematic observation in a clinical population [4]. The framework was influential because it

made the relationship an empirical question. Its weakness was the strength of the inference drawn from it: constitutional type was treated as explaining psychological disposition, on evidence that could not support a causal reading. Contemporary assessment retains the framing and rejects the inference. Physique and psychological characteristics may be studied as related dimensions of the individual; the relationship must be established empirically in each case, and the direction of any association remains open.

Sheldon, Heath and Carter

Sheldon introduced the term somatotype and the three-component description of physique — endomorphy, mesomorphy, ectomorphy — from photoscopic assessment [5]. His procedure carried two defects that later work had to remove: ratings depended on the assessor's judgement, and the somatotype was held to be a constitutional constant.

Heath's 1963 critique addressed both [6]. The subsequent comparison of methods [7] and the modified method of 1967 [8] replaced photoscopic rating with anthropometric measurement, opened the rating scales at both ends, and abandoned the assumption of lifelong invariance. Ten measurements are required: stretch stature, body mass, four skinfolds (triceps, subscapular, supraspinale, medial calf), two bone breadths (biepicondylar humerus and femur), and two limb girths (arm flexed and tensed, calf) [12]. Measurement is performed to the protocols of the International Society for the Advancement of Kinanthropometry, with declared technical error of measurement [13].

The rating is reported as three numbers in the fixed order endomorphy–mesomorphy–ectomorphy — for example, 2.5-5.5-3.0. The order is not a convention of presentation but part of the notation, and reversing it changes the meaning of each position.

The methodological gain is that physique ceases to be a category and becomes a position in a three-dimensional space, which is what makes comparison across groups, sports and time points possible [14].

Selye and the physiology of adaptation

Selye's work operates at a different level. Where the constitutional tradition described what the organism is, Selye described what it does when demand is imposed: a generalised response with a course through alarm, resistance and, under sustained excess, exhaustion [9–11].

The relevance to training is evident and has long been assumed. It is also contested. A substantial exchange in the sport science literature has questioned whether the general adaptation syndrome can bear the explanatory weight placed on it by periodisation theory, on the grounds that Selye's experimental models used noxious stressors rather than exercise, and

that the exhaustion stage is rarely observed in trained populations [17,18]. The defence has been that the criticism reads the model too narrowly and that the stress–adaptation link itself has not been dislodged [19,20]. The present framework does not require the debate to be settled. It uses the general adaptation syndrome as a description of temporal structure — that the response to repeated demand has stages, and that outcome depends on the relation between demand and recovery — and not as a mechanistic account of training adaptation. Where a mechanistic account is needed, contemporary formulations of allostasis and allostatic load offer a better-specified alternative [22].

The proposed model

The six stages address different levels of one problem, and the model set out here places them at those levels rather than merging them (Table 1).

Stage	Principal construct	Question addressed	Level of analysis
Hippocratic medicine	Constitution and environment	Why do identical conditions produce different outcomes?	Clinical–environmental
Galen; Ibn Sina	Mixture and temperament	How are bodily and behavioural characteristics related?	Systemic–descriptive
Kretschmer	Constitutional type	Can physique be related to psychological characteristics?	Typological
Sheldon	Somatotype (photoscopic)	Can physique be described in components?	Descriptive–morphological
Heath and Carter	Anthropometric somatotype	How can physique be measured reproducibly?	Metric–morphological
Selye	General adaptation syndrome	How does the organism respond to sustained demand?	Physiological
Present framework	Integrative adaptive profile	How do intention, morphology, load,	Multilevel

Stage	Principal construct	Question addressed	Level of analysis
		physiology and regulation interact?	

Table 1. Levels of analysis across the six historical stages and the position of the proposed framework.

The framework proposes eight levels, of which the first is the point of departure from conventional stimulus-driven models.

Level I — Intention. The individual forms an intention and an internal representation of the expected result. This is the anticipatory stage described by Bernstein [15] and specified by Anokhin as the action acceptor [16].

Level II — Action. The intention is realised as purposeful motor activity.

Level III — External load. The action produces a mechanical and metabolic demand, quantifiable independently of the individual performing it [21].

Level IV — Internal response. The organism responds through cardiovascular, respiratory, neuromuscular, endocrine and metabolic mechanisms. This response, not the external load, is what drives adaptation [21].

Level V — Stress response. Magnitude, duration and frequency of the stimulus, together with recovery, determine the character of the response [9,22].

Level VI — Adaptation. Repeated exposure with adequate recovery produces adaptive change; the same exposure with inadequate recovery does not.

Level VII — Psychological regulation. The individual appraises the outcome, and that appraisal modifies subsequent behaviour.

Level VIII — Result and feedback. The achieved result is compared with the anticipated one, and the comparison informs the next intention.

The sequence is cyclical rather than linear: the outcome of one cycle enters the next as a revised intention (Figure 1). Morphological, functional and psychological variables act at Levels III–VI as modulators — they condition the relationship between external load and internal response without determining the outcome of that relationship.

Figure 1. The proposed cyclical model. Intention and the anticipated result precede the motor act; morphological, functional and psychological modulators intervene between external load and internal response; the achieved result is returned as feedback to the next intention. [Figure to be supplied as a separate vector file in accordance with journal requirements.]

The position of the somatotype

Within this structure the somatotype is not a stage of adaptation. It is a morphological condition under which adaptation takes place, and it enters the model at Level III–IV as one modulator among several.

The interpretation is deliberately non-deterministic. A high mesomorphic component may be favourable for certain strength tasks without determining competitive outcome; a high ectomorphic component does not establish endurance capacity. Performance arises from the interaction of morphology, physiology, technique, accumulated training, psychological regulation and competitive context, and morphology is the component least able to be modified in the short term — which is a reason to measure it, not a reason to select on it.

The central proposition can be stated compactly: the somatotype does not determine adaptation; it characterises one of the morphological conditions within which adaptation occurs.

Operationalisation

The framework is operationalised as a profile with six blocks (Table 2). The blocks are intended to be assessed together, since the interpretive value of any one of them depends on the others.

Block	**Indicators**	**Function within the profile**
Morphological	Stretch stature, body mass, skinfolds, breadths, girths, Heath–Carter rating [12,13]	Describes body constitution
Functional	Heart rate response, vital capacity, maximal strength, recovery kinetics	Describes functional capacity
Motor	Strength, speed, endurance, coordination	Describes motor abilities
Psychological	Motivation, perceived exertion, stress appraisal, self-regulation	Describes psychological regulation
Adaptive	Response to repeated load, recovery rate, fatigue markers	Describes adaptive behaviour over time

Block	Indicators	Function within the profile
Performance	Sport-specific result	Integrated outcome

Table 2. Blocks of the integrative adaptive profile.

In talent identification this converts a single-point judgement into a staged procedure: morphological assessment, functional assessment, psychological assessment, assessment of response to repeated load, and only then an integrated decision. The order matters, because the earlier blocks are the more stable and the later blocks the more informative about trajectory.

Discussion. What the framework does and does not claim

The framework is a structure for organising measurement, not an explanation of adaptation. It claims that the constructs listed are distinct, that they are measured by different instruments, and that conflating them produces inferential error — most commonly the error of reading a morphological description as a prognostic statement. It does not claim that the eight levels correspond to discrete physiological processes, nor that the sequence has been observed as specified.

The relation to the general adaptation syndrome deserves particular care given the state of that literature [17–20]. The framework borrows temporal structure from Selye and not mechanism. Readers who reject the application of the general adaptation syndrome to training can substitute an allostatic-load formulation at Levels V–VI [22] without disturbing the rest of the structure.

Relation to existing load theory

The distinction between external and internal load is already established in contemporary sport science, together with the point that adaptation is driven by the internal response [21]. The present framework does not displace that formulation; it extends it in two directions. Upstream, it adds the anticipatory stage, on the basis of the physiology of activity [15,16]. Downstream, it makes explicit that the mapping from external to internal load is modulated by morphology as well as by fitness and fatigue, and that morphological modulation is measurable with existing standardised methods [12,13].

Adapted physical activity and Para sport

The framework is most consequential where the external-to-internal mapping is least uniform. Athletes with impairments differ in body proportions, distribution of muscle mass, mechanical constraints on movement, energy cost of locomotion and recovery characteristics,

so a standardised external load can produce widely divergent internal responses. In these populations the somatotype provides genuinely useful morphological information, and it is also the component most likely to be misread if taken alone. The practical implication is that anthropometric assessment should be scheduled alongside functional and psychological monitoring rather than as a preliminary screen.

Limitations

The framework is conceptual and awaits empirical test. Five limitations should be stated explicitly.

The review is narrative and non-systematic; source selection reflects the author's judgement and is subject to selection bias.

The classical and medieval sources are used for their methodological structure and are not equivalent to modern biomedical models; the interpretation offered here rests on secondary historical scholarship rather than on independent philological work.

No causal claim is made for any association between somatotype and performance. Cross-sectional associations of this kind are widely reported and are consistent with several causal structures, including selection effects.

Psychological regulation cannot be inferred from anthropometric characteristics, and no measurement in the morphological block should be interpreted as evidence about the psychological block.

The proposed sequence from intention to feedback requires experimental verification, ideally through longitudinal designs combining anthropometric measurement, functional monitoring and psychological assessment in the same cohort under controlled load.

Conclusions. The history of constitutional thought describes a movement from qualitative description toward reproducible measurement, and the Heath–Carter method represents the point at which physique became a measurable position rather than a category. Selye's work supplied a complementary temporal account of what the organism does under demand. Neither, on its own, answers the question that motivates both.

The framework proposed here places the somatotype among the modulators that stand between an imposed load and the response it produces, alongside functional capacity and psychological regulation, and adds the anticipatory stage that stimulus-driven models omit. The methodological objective it implies is a change of question: not what body type an athlete has, but how this organism, with its particular morphological, functional and psychological characteristics, responds to a given demand, adapts to it, and regulates what follows.

That shift — from classification to interaction, from static type to adaptive profile — is the contribution claimed. Its value now depends on whether the structure survives empirical test, and the immediate priority is a longitudinal study in which somatotype configuration, functional capacity, psychological regulation and recovery are measured concurrently under standardised load.

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