Authors' Reply to Buckner et al.: 'Comment on: "The General Adaptation Syndrome: A Foundation for the Concept of Periodization"

By: Aaron J. Cunanan, Brad H. DeWeese, John P. Wagle, Kevin M. Carroll, Robert Sausaman, W. Guy Hornsby III, G. Gregory Haff, **N. Travis Triplett**, Kyle C. Pierce, and Michael H. Stone

Abstract

Buckner et al. [1] have submitted a letter in response to our recent review [2] on the general adaptation syndrome (GAS) and its application to training periodization. As Buckner et al. state, this topic deserves fair and thorough discussion from multiple perspectives, and we thank them for the opportunity to continue such dialogue. Their letter restates many of the points in their original reviews [3, 4], which we addressed in our manuscript. Nevertheless, we will address the main points of their letter to provide further clarity on how the GAS does in fact serve as an appropriate mechanistic model to conceptualize training periodization.

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1 Introduction

Buckner et al. [1] have submitted a letter in response to our recent review [2] on the general adaptation syndrome (GAS) and its application to training periodization. As Buckner et al. state, this topic deserves fair and thorough discussion from multiple perspectives, and we thank them for the opportunity to continue such dialogue. Their letter restates many of the points in their original reviews [3, 4], which we addressed in our manuscript. Nevertheless, we will address the main points of their letter to provide further clarity on how the GAS does in fact serve as an appropriate mechanistic model to conceptualize training periodization.

2 Data Have Been Ignored?

Buckner et al. [1] suggest that only Selye's original experimental papers should be considered when examining the potential applications of the GAS, and thus dismiss the relevance of reviews by Selye that do not present additional data. We are perplexed by and fundamentally disagree with this position as it implies (i) one cannot expand, amend, or revise his or her conclusions about a topic without new data, despite any apparent advances in scientific knowledge, (ii) literature reviews do not contribute to the scientific knowledge, and (iii) Selye was unqualified to comment on the GAS.

A detailed explanation linking Selye's experimental data to periodization is not possible in this limited space, but we refer readers in particular to Selye's summary of experiments [5], in which the data in Tables 1, 2, and 3 support, at least conceptually, the basic training principles of overload, specificity, variation, and reversibility, which are fundamental to modern periodization. Additionally, Viru [6, 7] provides clear summaries linking the GAS to training adaptations. As we suggest in our review [2], the restricted perspective adopted by Buckner et al. [1] "inexplicably omits substantive developments of the GAS concept that evolved from Selye's original experiments, and leads the authors to argue against isolated components of the GAS removed from scientific and practical context". Furthermore, it leads these authors to misinterpret what the GAS is, which we address in the following section.

3 What is the General Adaptation Syndrome?

Buckner et al. [1] claim that their position is based on Selye's original experimental papers; however, they ignore a notable interpretation made by Selye during such work. Namely, Selye referred to his data on changes in thymus weight and mortality as *indices* of an animal's resistance to

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a stressor [4]. That is, these data were surrogate measures of the animal's functional state (i.e., resistance/adaptation). Although Selye highlighted several common physical changes (e.g., thymus involution), it is clear from his detailed cataloguing of variable symptoms arising in response to specific stimuli [5, 8, 9] that the GAS is not defined as any single set of physical symptoms. Selye emphasized the functional effects of the GAS, not just the rote documentation of any accompanying physical changes. However, in their review, Buckner et al. [3] seem to ignore this point with their suggestion, in reference to the GAS, that ''the most effective periodized program would produce the least amount of thymus involution and adrenal hyperplasia'', which we view to be a mischaracterization of Selye's experimental work and the GAS.

4 How Dangerous is Exercise?

Buckner et al. [1] criticize our citation of Selye's remarks on the periodicity of stress and recovery. However, the passages they quote from Selye's review [10] again mischaracterize Selye's statements through the omission of relevant material. The section in question is titled 'The Physio-pathology of Periodicity' and does highlight pathologies arising from a lack of periodicity. However, Selye notes that "stress-reactions…are well tolerated only during short periods and tend to cause severe complications if they act upon the body persistently over a long time'' and suggests a potential benefit in the therapeutic application and withdrawal of stress. Although Selye does not explicitly mention 'acute exercise' (he does, however, mention 'muscular work', as Buckner et al. [1] quote in their letter), the GAS is nonspecific and applies, in general, to various stressors—acute exercise notwithstanding. Therefore, these statements provide guidance on the possible beneficial and pathological outcomes in response to stress, and, if the GAS is applied to training, imply the need for planned variation (e.g., heavy/light days) and rest. Furthermore, several studies have documented the negative effects of sustained high training loads [11–14], and the apparent interactions between training load, performance, subjective wellness, and risks [15–25]. Thus, Selye's statements and available evidence may also imply the need for cyclical variation of training loads across phases. Although sufficient longitudinal data are lacking in the existing literature, it is worth noting, from observations and conversations with international coaches in the sports of weightlifting and track and field, that training systems that employ relatively little variation of volume, intensity, and/or exercise selection are associated with the highest incidences of performance-enhancing drug use, suggesting that such unvaried training methods may exceed the normal physiological capabilities of humans.

Finally, Buckner et al.'s [1] dismissal of formal definitions of periodization and programming only serve to contribute to the confusion and controversy surrounding these concepts. In a review from this group, Mattocks et al. [4] largely compare the effects of different loading schemes (i.e., programming) rather than the sequential development of fitness characteristics (i.e., periodization). As they note, the principle of specificity suggests that training should closely match one's competitive demands. However, most sports require a vast repertoire of skills and tactics underpinned by a wide range of forces, rates of force development, movement amplitudes, movement velocities, bioenergetic flux, etc. Simultaneously addressing the gamut of all these qualities is unfeasible and likely detrimental to the athlete and his or her performance. Buckner et al. [1] acknowledge the fact that some planning is necessary to account for the various stressors an athlete may encounter. Given the principle of specificity, if one allocates the targeted development of multiple fitness characteristics to different periods of time, whether out of practicality or more deterministically, the training content during each of those phases must vary. Additionally, the sequencing and specific content of those phases can impact training outcomes [26–28]. Furthermore, even sports that require the development of relatively few fitness characteristics (e.g., weightlifting, powerlifting) require, at the very least, some variation in loading (i.e., not always lifting one repetition-maximums), not to mention the common scenario of such an athlete attempting to move up a weight class (i.e., develop muscle hypertrophy). Therefore, we contend that planning training requires more than simply accounting for an athlete's total stress, and that periodization is an effective method for planning and organizing the many factors of training.

5 Conclusion

Buckner et al. [1] have based their opinion on an incomplete version of the GAS and with disregard for formal definitions of periodization. Even during his early work, Selye was concerned with the functional significance of the GAS. The functional changes in resistance/adaptation observed during the GAS are clearly seen in response to training. The fitness-fatigue paradigm [29, 30] is especially useful for understanding this functional perspective of the GAS in relation to training and performance. Additionally, research on the time courses of various adaptations, appropriate stimuli for specific adaptation(s), and the influence of 'conditioning factors' suggest the need for the

careful planning of sports training. The GAS and periodization provide conceptual frameworks within which to apply such scientific findings.

Compliance with Ethical Standards

Conflicts of Interest Aaron Cunanan, Brad DeWeese, John Wagle, Kevin Carroll, Robert Sausaman, W. Guy Hornsby III, G. Gregory Haff, N. Travis Triplett, Kyle Pierce, and Michael Stone declare that they have no conflicts of interest relevant to the content of this letter.

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