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Manuscript Clarification Response

Dr Lindsay Bottoms Ph,D, MSc, BSc(hons)

University of East London, Senior Lecturer, School of Health, Sport and Bioscience, Water Lane, Stratford, UNITED KINGDOM, London

Corresponding Author: University of East London, Senior Lecturer, School of Health, Sport and Bioscience, Water Lane, Stratford, UNITED KINGDOM, London, phone : +44 7854008816

Thank you for raising these issues and the debate this has generated. Below we have responded to all your points, where our aim is to show that our contention is not with the need to develop an aerobic base, but rather the extent to which it should be developed and the methods used in achieving this. Also, while we recognize there are three swords, we will outline an argument that the strength and conditioning (S&C) programming for these does not differ. Naturally these are our inferences so at times it is not about disproving your argument, but rather presenting a logical alternative.

1. *Weapon specificity, i.e., there are three swords all must be trained differently.*

   We disagree. While it is safe to assume that the athlete of each weapon has varying degrees of speed, power and aerobic capacity, these differences are likely developed through the demands of actual sports training and competition. That is, the fencing coach of each sword wants the fencer to lunge, change direction, and recover as fast as possible, and also wants them to be lean and highly reactive etc. These are common goals across all swords and may explain why research in fencing typically looks to quantify the time of a lunge, or the speed of a movement etc., irrespective of sword (Gholipour, Tabrizi, & Farahmand, 2008;

Gresham-Fiegel, House, & Zupan, 2013; Guilhem, Giroux, Chollet, & Rabita, 2014; Gutierrez-Davila, 2011; Stewart & Kopetka, 2005; Tsolakis & Vagenas, 2010; Tsolakis, Kostaki, & Vagenas, 2010); some studies do not even define the sword type (Tsolakis & Vagenas, 2010; Tsolakis, Kostaki, & Vagenas, 2010; Tsolakis, Bogdanis, Vagenas, & Dessypris, 2006). The S&C coach will thus train each component and aim to maximize the capacity of each. They could not train an epee fencer to be 70% fast, while a foil and sabre fencer 80 and 90% respectively. Instead, the nature of their weapon will govern the extent of these adaptations. Epee is certainly more aerobic than sabre, so you would expect sabre to retain strength and power adaptations better, while these would compete and ultimately compromise with the muscle physiology of an epeeist who also requires additional endurance capacities. Finally, to use and interpret the meaning behind your analogy of rugby league vs. rugby union, we disagree again. In actual fact, and we would go one step further; you would find it difficult to identify the sport in question by merely looking at the S&C programme of any sport. There are countless examples of sports using squats, weightlifting, interval training and aerobic training for example, to improve the performance of their athletes. The difference is normally the frequency of each, rather than the type.

2. *Research papers alluding to the demands for an aerobic base in fencers*

It is important to note (and is stated in the paper), that our contention is not with the need to develop an aerobic base, but rather (1) the extent to which it should be developed (see page 3003, column two, paragraph two) and (2) the methods used in achieving this (see page 3004, column 2, paragraph one). You cite papers that

support your argument to develop the aerobic capacity of fencers. In turn, they are refuted below, thus explaining their exclusion from our review.

Bottoms, et al., (2011).

This paper identifies the average VO_{2peak} in elite fencers as 46.9 ml/kg/min. We do not regard this as high, nor does it represent values attained by trained athletes in aerobic sports. Even the textbook of the National Strength and Conditioning Association (for whom this journal is affiliated) regards this value as untrained (Table 6.2, page 133) (Baechle & Earle) and is only slightly higher than that of weight lifters (45.3 ml/kg/min) (MacFarlane, Northridge, Wright, & Dargie); additional data across sports is available in the review of Pluim et al., (2000). Furthermore, our paper states that we question the need to develop capacities in excess of 60 ml/kg/min. The value presented by Bottoms et al., (2011) is indeed low and would thus be increased, albeit indirectly by virtue of the high-intensity interval training we recommend based on several research papers (Baker, 2011; Helgerud, Hoydal, Wang, Karlsen, Berg, & Bjerkaas, 2007; Wisloff, Stoylen, & Loennechen, 2007). Finally, we would also suggest that the values recorded by this paper do not actually represent competition data and that you have sold your argument short here. We find training based sparring to be significantly lower in intensity than competition bouts, likely on account of familiarity with the opponent, and the lack of arousal associated with insignificant win rewards (unpublished data that we aim to submit post Olympics 2016). We are therefore forced to manipulate sparring and fitness sessions to promote adaptations in this context.

Koutedakis, et al., (1993).

This paper merely identifies changes in aerobic capacity across a season. Its inclusion as a test is based on fencers having a significantly higher aerobic capacity than untrained, age matched controls. There is nothing to assume that this was related to performance and success. In fact, knowing the history of results and that these fencers were British (for whom I work for), it did not. While you may suggest that British fencers regularly win the Common Wealth Games, this is not regarded as an appropriate benchmark for success, given that there are no "high-level" competing nations; funded British fencers on the performance pathway do not typically compete at this (however, we certainly acknowledge the prestige of this competition). In summary, this paper is not valid for supporting your argument.

Weichenberger & Steinacker, (2012).

The aim of this paper was to develop an aerobic test for fencers. It did not justify its validity and given the basis of our argument, it has none. This does not support the premise of your argument.

Sobczak & Smulsky, 2006.

We cannot find this resource

3. *Bottoms et al., (2011) have shown that aerobic metabolism is important to fencing.*

   The paper of Bottoms et al., (2011) is refuted above and we believe, for the same reasons, invalidates the contention here.

4. *Fatigue effects shot accuracy and technical proficiency, and conclusions regarding the significance of the aerobic capacity reported by Wylde et al., (2013) were omitted.*

   There is no argument here. We agree that fatigue effects technical proficiency and accuracy. However, high heart rates (which we too have measured in that range) do not imply an association like you suggest. Weight lifters have high heart rates across sets of their exercises.

   Re your latter point, you are correct; we omitted the reference to developing an aerobic capacity. However, our conclusions are the same as this paper's, which we would interpret to actually dispute your argument. Starting on page 373, paragraph four, it reads *"while long slow distance running may not be essential, aerobic endurance training should be integrated into elite fencing training, through bouts, lessons and endurance-oriented footwork. This sound aerobic base will enhance recovery between bouts and fights although not necessarily improve performance"*.

5. *Fencing matches last 3 min, not 5 min.*

   Apologies for the inaccuracy here, you are correct. We were over concise as pool bouts typically last 5 min as cited by most, including Wylde et al (2013) i.e., "*4-6mins*". However, we did state the length of the day is ~ 10 hours. This is probably the hardest part of fencing as (in our opinion) most confuse a competition duration of this length as justification for the training of high aerobic capacities. But as stated in our review paper (see page 3002, column one, paragraph one), and omitted from your argument, bouts and actual fight time

consist of only 13 and 5% of the actual competition time, respectively. That means that for ~ 9 hours of that day, fencers are resting. We simply advise they "rest" better. For example, our training is about establishing what recovery and nutrition interventions we can do that fit the logistics of competition, and thus optimize subsequent bouts.

6. *More data on each weapon is needed*

   Agreed, more research is indeed needed, and we hope to publish additional data post Olympics to further our understanding.

Author Biography

Anthony Turner is the Programme Leader for the MSc in Strength and Conditioning at Middlesex University, London, England and is the head of Physical Preparation at British Fencing

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