

Is fatigue in your head? The use of deception to study the psychology of strength and anaerobic fatigue

The Central Governor Model (CGM) of fatigue proposes that exercise performance is restricted and regulated by the central nervous system to make certain that during normal exercise, catastrophic failure (e.g. heart failure) does not occur.¹ However, not everyone agrees with the CGM, including Weir et al,¹ who believes that the CGM does not adequately account for the peripheral factors that contribute to fatigue (e.g. changes within the muscles). If fatigue is at least partially regulated by the brain, then psychological factors should alter a participant's performance. One example of a method to manipulate the psychological factors associated with fatigue is the use of deception. Williams et al² used deception by increasing time trial paces for competitive cyclists without their knowledge and found that the cyclists increased speeds by 2% and 5% compared to their previous trial. Stone et al,³ also found that cycling time trials significantly changed when the cyclists were deceived. In a study done on self-efficacy in weightlifters by Fitzsimmons et al,⁴ participants were broken up into three groups: one was told they were lifting less than they were, one was told they were lifting more than they were, and the other was given accurate feedback. Fitzsimmons et al⁴ found that the deception resulted in the subjects lifting more weight. Stone et al⁴ notes that it may be possible that, since the central nervous system controls the intensity one puts into a task, performers may be performing at a lower intensity than they are physiologically capable of.

With the exception of Fitzsimmons et al., most previous studies have used aerobic, endurance exercise to study the psychological influence on fatigue with time or pace being the variable that is deceptively altered. One of Weir et al's¹ criticisms of the CGM is that it does not predict anaerobic fatigue (changes in strength) very well. Therefore, we would like to use deception to examine the psychological factors that influence anaerobic fatigue and strength. There will be a total of 15 participants that will each come into the Applied Neuromuscular Physiology Laboratory for one visit, lasting approximately one hour. Each participant will do four maximal contractions and one submaximal, sustained contraction during their visit. The first maximal contraction will be at 100% to assess the participant's baseline because we need to know their true max in order to manipulate it correctly. We will then manipulate the live feedback of their force output for the next three contractions on the monitor, which the participant will be led to believe is their true max. We will be manipulating those contractions to be lower (e.g. 95% of max) or higher (e.g. 105%) to see how the participant's change in perceived effort and ability affects their strength. We will also do one manipulation that would be considered too large of a deception (e.g. 110%) to examine the effects on the participant when the task is blatantly too difficult. In a previous study using deception during cycling time trials, it is noted that those who realize they are failing have a lower self-efficacy and avoid the attempt to reach such a high goal.² We hypothesize that subtle deception will improve performance, while too large of a deception may be detrimental to performance. We will also examine the participant's ability to resist fatigue and whether or not it is dependent on their expectations of the task. The participant will be asked to maintain a constant-intensity, submaximal contraction for as long as possible (i.e. until fatigued). We will "prepare" subgroups of the participants for this task by giving each subgroup a different expectation. For example, one subgroup will be told prior to the task that they should be able to hold that particular intensity contraction for at least 1 minute, while another subgroup may be told that they should be able to hold it for at least 5 minutes. The subgroups will reveal whether the differences in fatigability are dependent on the subject's perception of the fatigue task.

Stone et al³ found that most studies are consistent with the knowledge that most athletes operate with metabolic reserve, showing that they can perform better if their brain wasn't tricking them. This study will help define the extent of influence psychological factors, such as expectations of task, perceived effort, and self-efficacy, have on strength and anaerobic performance. Understanding the psychological side of fatigue may lead to a better grasp of the mechanisms that cause fatigue, the accuracy of the CGM, and insight on a possible psychological intervention to improve strength.

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2. Williams EL, Jones HS, Sparks SA, et al. Altered psychological responses to different magnitudes of deception during cycling. *Medicine & Science in Sports & Exercise.* 2015;47(11):2423-2430.
3. Stone MR, Thomas K, Wilkinson M, Jones AM, St. Clair Gibson A, Thompson KG. Effects of deception on exercise performance: Implications for determinants of fatigue in humans. *Medicine & Science in Sports & Exercise.* 2012;44(3):534-541.
4. Fitzsimmons PA, Landers DM, Thomas JR, van der Mars H. Does the self-efficacy predict performance in experienced weightlifters? *Research Quarterly for Exercise and Sport.* 1991;62(4):424-431.