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The Effects of Warmups, Music, and Rituals on Performance Recovery and Enhancement

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Athletes, soldiers, and business men/women alike all need to perform optimally in order to achieve their goals. It does not seem, however, that most people that want this high level of execution consider the possible ways in which they can inhibit this. In this paper we will explore the different types and variations of performance preparation and how they might enhance, diminish, or be ineffective towards the outcome of performance (as well as the attitudes they give athletes). Between all the different types of preparations, there are both physical and mental (which includes emotional) components, which aim to measure the impact a preparation would have. To illustrate, something like stretching will likely be a more physically oriented behavior (done to impact your physical capabilities), while listening to music is a much more mentally oriented behavior.

We will first focus on different types of performance preparation that deal a with more physical centric preparation. Research observing the effects of cycling on Plantar Flexion PAP (Post activation potentiation) used measures such as the peak tension (PT), the time it takes to reach peak tension (TPT), and the contraction duration (CD) to measure these potentiated twitches, both before and after exercise (Simpson et al., 2018). These measures were utilized to find differences between men and women. Its important to note that the research was conducted on female participants that are using oral contraceptives at the time of the study. Oral contraceptives can influence hormones as well as the concentration of calcium in the body, an important component of physical kinetics and calcium signaling in the body, which may limit results to women on oral contraceptives. What the results concluded was that the TPT and CD of Plantar Flexion was reduced in both men and women after only ten minutes of cycling (Simpson et al., 2018). This means that on average the men and women in this study experienced a higher level of Plantar Flexion efficiency in comparison with themselves prior to the warmup. Where

things get interesting; women from this study seemed to on average to have a higher degree of PAP change overall when compared to the men from this study (Simpson et al., 2018). What all of this indicates to us is that there is perhaps a benefit to cardio and/or the movement of relevant body parts for athletes (especially females), in order to increase the responsiveness of a bodily area. Unfortunately, the study was not replicated with women that are not taking oral contraceptives, so we are unable to conclude whether or not birth control was the determining variable and therefore can not say for certain whether this applies to women not using oral contraceptives.

Another popular form of warm up/conditioning athletes and others alike use is the foam roller. Foam rolling itself is advertised as a way to reduce soreness in muscles, and “activate” them as well. The specific purpose of Healy et al’s paper was to observe and measure the effects of foam rolling on metrics such as the persons vertical jump and height, strength, and agility in comparison to the control (planking) (Healy et al., 2014). Procedurally, the participants were given a series of light exercises to complete and their times (and overall performance) were recorded. Upon completion, subjects were separated into two groups, one that had to plank (control) and one that had to use the foam roller (experimental). They were then instructed to complete the series of light exercises again, to see if there was a change in overall performance. The results of the study conclude that foam rolling seems to be ineffective at increasing the performance as well as reducing any form of soreness or fatigue (Healy et al., 2014). Massaging, another popular physical technique, proved no better and in fact may have been worst for strength related performance. A study that measured the effects of massaging legs found that muscular strength was significantly reduced after only 6-15 minutes of massaging (Wiktorsson-Moller et al., 1983). Both static or non-activation-based methods of physical preparation and

maintenance seems to have had no effect in this study. What we might be able to draw from this is that more physically oriented performance preparations seem to be ineffective, according to what we have found.

We will now take a look at more mentally oriented forms of performance preparation. The biggest type of mental oriented behavior in sports and exercise is music selection and listening. It is well-documented that athletes will often listen to music during workouts, pre/post performance, and even during rest time. Terry et. al. comprised a long list of English written papers on this very topic to see just how much music can affect the performance of athletes. The only major limitation of this meta-analysis aside from it being limited to English written papers, is that it inherently relies on the work of other researchers. This means that the quality and quantity of research on the topic can limit the conclusions drawn from this review. Conclusions drawn all point toward music having a very weak effect on the overall performance of athletes, which most would consider negligible (Terry et. al., 2020). This is not to say that music is not affective, but rather the studies themselves found it difficult to find effective music. One of the studies used concluded that some of the major factors that play into music's affect on the listener is their preference, mood, and their selection of music (Karageorghis et al., 2017). They further elaborate by saying that their study specifically yielded insignificant results, but they believe that the data suggests music is not a factor that can be easily generalized to everyone. Different music preferences may play an important role on the affect it would give the listener. They did however find that runners listening to higher tempo music that is considered "positively-valenced" rated higher on the Feeling Score, meaning that on average, high tempo music resulted in a positive effect on the acute recovery of runners that performed high intensity training (Karageorghis et

al., 2017). To summarize, it seems music may affect performance indirectly from the affect it has on mood, which is then able to increase performance, by allowing for better concentration.

We now shift our focus to the final category of this paper, which is techniques that use both physical and mental components. Rituals are a great example of techniques that utilize physical and mental aspects. Hobson et al. does a great job of describing both components related to a ritual in his analysis. He describes the rituals given to the participants as being repetitive and sequential movements along side a set of prescriptive and rule-bound directions (Hobson et al., 2017). The sequenced movements acted as the physical component, and this concept of “rule-bound instructions” are the mental component. The directions act as a substitute for attitudes and beliefs that athletes hold during their performance, and the expected outcome of such. There are however many different types of rituals that exist. Not only are there group rituals, separate from individual, but there are different types of rituals within each category (Fischer et al., 2013). While research about each ritual type is sparse, Fischer et al. studies the use of synchronous movements and sacred teachings/beliefs to explore the possible effects of synchronous rituals (Fischer et al., 2013). What both studies conclude is that rituals can be useful for a multitude of reasons.

First, rituals seem to be beneficial for self-regulation and goal attainment, which meant that the rituals created a sense of comfortability for automatic movements within participants (Hobson et al., 2017). Second, rituals could be used to decrease the response towards failure, as rituals typically shifted the participants locus of control to being more external. In a real-life scenario, this means that the blame off shifts off of an athlete, resulting in an ability to emotionally and mentally recover from losses quicker. Lastly, we found that synchronous rituals can elicit strong cooperative attitudes and behaviors when utilized in a team setting. “Prosocial

attitudes and behaviors” as they are referred to in the journal, means that an individual will display more helpful and cooperative manner when in a group, as a means of bettering the group (Hobson et al., 2017). Research on rituals seems to indicate that it can have quite the effect on performance, and that its affects are seemingly multifaceted. Seeing as little research has been conducted about its affect in the realm of sports and exercise, we can only assume that there may be more benefit that is unknown.

Another technique that also applies to both physical and mental preparation is detachment. Detachment, or the abstaining of performing a task, is unique as it has both properties of preparation, but does not require any action to occur (Balk, 2017). Detachment can mean performing a separate task, but often times the task being performed is not connected or related to the performance of the athlete. So how would this influence the performance of an athlete? Well, as it turns out, a survey conducted on elite Dutch athletes found some interesting answers. Physical detachment from exercise and performance for brief periods throughout the day positively affected the level of physical recovery seen in the athletes (Balk, 2017). This is to be expected, naturally, as fatigue can lower performance and not performing physically allows for rest. What we find is that the same applies for mental recovery. As stated in the beginning of this paper, the mental component of performance and recovery also includes emotions, and by association “emotional performance and recovery”. What the survey helped conclude is that an emotional detachment, or the use of brief periods of distractions that help regulate or ignore your moods saw a positive effect on mental recovery (Balk, 2017). What all of this means is that taking breaks can allow for athletes to recover quicker, allowing for more efficient training.

In summary, athletes have a multitude of techniques at their disposal that they can use to enhance recovery and performance. With that being said, it seems that more mentally oriented

techniques such as music, rituals, and detachment seem effective or even show promise by comparison to physically oriented techniques such as massaging and foam rolling. Expected outcome does however play a major role into how humans react to solutions, so it is perhaps possible that any one of these techniques could work, given you are expecting a change.

Ultimately, the field of Sports and Exercise Psychology is still budding, and this paper leaves many unanswered questions. Future research could prove invaluable for identifying better techniques of recovery and performance, and this paper is only the beginning.

Annotated Bibliography

Simpson, C. L., Flatman, M. M., Kim, B. D., Bouwmeester, N. M., & Jakobi, J. M. (2018). Increase in post activation potentiation in females following a cycling warmup. *Human Movement Science*, 57, 171-177. doi:10.1016/j.humov.2017.12.003

The research conducted by Simpson et al. explores the post action potentiation (or PAP as it is referred to in the text) of the lower legs in men and women. This paper expresses that variables such as gender and physical fitness can have an effect on PAP, and uses this previous research on the topic to expand into its major purpose. This paper's major purpose is to explore the effects of a warmup on post action potentiation. The warmup they use in the study is cycling in ten-minute intervals, and the specific part of the lower leg they focus on is the Achilles tendon and the complementary muscle groups. They use a technique known as ultrasonography to measure the frequency of the twitches at the muscle tendon junction in the Achilles, and conduct before and after measurements of all the participants. Participants are asked to activate their Plantar Flexion for the measurements and all other variables, such as leg position and angle are kept constant between everyone.

I found this source to be thorough in its explanations and methods, but lacked reference to any other PAP studies on other areas of the body. I also think that this information will be hard to generalize, as the number of participants was twenty-two (eleven males, eleven females). All the female participants were on contraceptives, which is a variable I would have liked to see the other side of as well.

Healey, K. C., Hatfield, D. L., Blanpied, P., Dorfman, L. R., & Riebe, D. (2014). The Effects of Myofascial Release with Foam Rolling on Performance. *Journal of Strength and Conditioning Research*, 28(1), 61-68. doi:10.1519/jsc.0b013e3182956569

This paper researched the effects of self-myofascial release (SMR as its referred to as in the article) with foam rolling, as there is not much in the way of evidence to back the claims made by many. The claims are ones of a positive result when it comes to physical performance and the decreasing of dysfunction from microtraumas when paired with foam rolling, so we are primed to expect significant results. The testing was standardized and every external variable is counter measured to ensure the data is not skewed. Results concluded that standard foam rolling pre and post workout seemed to have little effect on myofascial release, and it is speculated that foam rolling may be a form of placebo.

This source thoroughly explained the type of test conducted, and also gave other metrics that were measured aside from myofascial release, such as fatigue, soreness, and exertion. The participating sample was small in this study, with a sample size of twenty-six (thirteen men, thirteen women), meaning its difficult to attribute the results to an entire population. The only true effect observed in the study was that foam rolling was less fatiguing than planking among the participants, which is not a surprise by any means.

Wiktorsson-Moller M, Oberg B, Ekstrand J, Gillquist J. Effects of warming up, massage, and stretching on range of motion and muscle strength in the lower extremity. *Am J Sports Med* 11: 249-252, 1983.

This paper researched the effects of both massaging and stretching on range of motion and performance. They tested all the muscle groups of the legs in this study, which includes quadriceps and hamstrings. The testing was standardized and most external variables were accounted for (aside from ones I mention later). The test found that stretching helped increase the range of motion in the hips (both flexion and extension), hip adduction, knee flexion, and ankle dorsiflexion. Stretching in general greatly benefitted when compared to massaging, warming up, or both combined.

This source tested and compared multiple types of muscle recovery, and gave comparisons and results for each. There was a small sample for the experiment, with a sample size of eight (all were men). The lack of gender representation along with the small sample size might make this a difficult study to be able to generalize, or correlate to the general masses. I also am not a fan of the minimalist results and conclusion sections, as they could have been expanded upon and more fleshed out.

Hobson, N. M., Bonk, D., & Inzlicht, M. (2017). Rituals decrease the neural response to performance failure. *PeerJ*, 5. doi:10.7717/peerj.3363

This paper looks into the reasons and attitudes associated with performing rituals for athletes, and how they affect the neural response of athletes after performance. As the title suggests, the findings conclude that rituals have a significant impact on the neural response to performance failure, meaning that the participants on average did not elicit as strong an emotional and behavioral response after performing a ritual, as well as guides goal-directed performance. They used a metric known as the error-related negativity (ERN as it is referred to as in the paper) to determine the level of response post activity, and whether there is significant change. They also utilize EEGs (electroencephalographs) to measure higher function parts of the brain during the performance of novel rituals.

Overall, I believe that this paper had some redeeming qualities, and others that left lots to be desired. For starters, sports psych being such a niche field means that often times experiment sample sizes are small, but in the case of this experiment it ended up being significantly larger (fifty-nine participants total). They decided to get all their participants from a entry level psychology course at the University of Toronto which limits the scope to college students and those with an interest in psychology.

Fischer, R., Callander, R., Reddish, P., & Bulbulia, J. (2013). How do rituals affect cooperation? *Human Nature*, 24(2), 115-125. doi:10.1007/s12110-013-9167-y

This paper looks more into the collective ritual of a team, and analyzes several types of rituals to see their effects on the attitudes of fellow participants and the decisions made in a public goods game. These measured affects in the paper are called prosociality. For this experiment, groups are preexisting and are performing a variety of tasks/sports. This paper

believes that group synchrony will increase prosociality, and sacred values will mediate a ritual's prosocial affect. Weirdly enough, the researchers decided to use Hindu and Buddhist teachings for the sacred values, even though the research was conducted in New Zealand on a majority New Zealand European sample. The results found that rituals with synchronous movement increased prosocial attitudes, and rituals judged as more sacred was associated with the largest contribution in public goods game.

The sample size is fairly large in this experiment, with a size of one hundred and thirteen participants, which I like. But, of the fifteen groups that were contacted about conducting the experiment, only nine of them actually followed through and were studied. This means there was a possible response bias at play in this experiment. I appreciate the level of detail that the results had, it leaves this paper feeling well polished.

Balk, Y. A., De Jonge, J., Oerlemans, W. G., & Geurts, S. A. (2017). Testing the TRIPLE-MATCH principle among DUTCH elite athletes: A DAY-LEVEL study on Sport DEMANDS, detachment and recovery. *Psychology of Sport and Exercise*, 33, 7-17.
doi:10.1016/j.psychsport.2017.07.006

This study uses a week-long online diary system to track and record the recovery state and time of all athletes in terms of physical, mental and emotional rest. The times in which these states were recorded were in the morning after waking up, and again right before bed. The results from the study concluded that daily physical detachment (detachment is a break from the task of using that aspect of oneself) positively related to physical recovery, and emotional detachment positively related to both cognitive and emotional recovery in the athletes. This paper helps us to conclude that detachment helps with an athlete's recovery and therefore detachment should be implemented into an athlete's recovery process.

I think this source has some great features, and some that are not. First off, this study was conducted on actual athletes, and many of them (sixty-eight total), which is better than most other studies in this realm of psych. Studies in this vein of psychology typically rely on participants that are more readily available, rather than athletes. This study also used a multilevel regression analysis of within subject design, allowing for a rigorous and internally valid study. Unfortunately, this means the study will be difficult to apply to an outside population, or at the very least to others that are not athletes.

Balk, Y. A., & De Jonge, J. (2021). The “underrecovery trap”: When physical fatigue impairs the physical and mental recovery process. *Sport, Exercise, and Performance Psychology*, 10(1), 88-101. doi:10.1037/spy0000249

This supplemental paper researching and discussing the affects of extreme physical fatigue on the physical and mental recovery of an athlete goes hand in hand with the previous paper mentioned above. This paper expands upon the detachment styles and methods mentioned up above, and hypothesizes that developing healthy and affective post performance strategies for alleviating fatigue are important to improving recovery times. Quite obvious, but one of the major conclusions provided by this supplemental research was that high daily physical and

emotional demands from competition and exercise was associated with high physical fatigue, which really is a given.

This paper does a good job of expanding upon the ideas in the previous paper, by adding more to the study than was previously mentioned. A few metrics that was never really explained was what determined “elite athletes” from regular ones, and how that would affect the results of the study. The biggest thing I feel this paper failed to do was explain exactly what an “under recovery trap” is, rather than just using that terminology to describe a phenomenon that has long been observed by society to begin with. One thing I liked about this paper was that it successfully studied more athletes than the last, being able to record data from a total eighty five athletes this time around.

Terry, P. C., Karageorghis, C. I., Curran, M. L., Martin, O. V., & Parsons-Smith, R. L. (2020). Effects of music in exercise And Sport: A meta-analytic review. *Psychological Bulletin*. doi:10.1037/bul0000216.supp

This paper aims to measure the effectiveness of music as a means of performance enhancement, as well as the health benefits that are associated with listening to music. In the review of literature on this topic, the authors find that there seems to be many hypotheses that state music will benefit salient affects that could favor athletes and performers. They use these previous papers as inspiration to complete an experiment on the effects of music on physical activities. What they found was that faster tempo music had the greatest positive affect on performance, and music promoted a more positive affective valence, enhanced physical performance, reduced perceived exertion, and improved physiological efficiency.

This paper succeeds at a few things. It successfully includes many outside sources, making this one of the most thorough sources I have read. This paper also does a very good job of elaborating and explaining all of the limitations of the research. This paper was best at expressing its concern over all the different degrees of freedom and minute differences in variables that can cause a big difference in results (like tempo, for example).

Jones, L., Tiller, N. B., & Karageorghis, C. I. (2017). Psychophysiological effects of music on acute recovery from high-intensity interval training. *Physiology & Behavior*, 170, 106–114. <https://doi.org/10.1016/j.physbeh.2016.12.017>

This paper helped to show how music can affect recovery from exercise. Its aim was to show how music seemed not to have a strong affect on performance. What it did however show, is that music can influence mood, which in turn might help an athlete better focus on performance.

This paper succeeded at being concise and providing a means of showing possible future research topics within the realm of sports and exercise psychology. Music being such a subjective artform may have made things a bit complicated. I think what the paper lacked was an in depth look into the other possible dimensions of music that may have been responsible for this affect.