Understanding Mental Toughness and Stress: The Role of Cortisol

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Understanding Mental Toughness and Stress: The Role of Cortisol

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Abstract

Mental toughness research aims to understand how two people of the same skill level, experience, and background react to pressure and stress, with one succumbing to the pressure while another succeeds (Clough & Strycharczyk, 2012). This study used Clough, Earle, and Sewell’s (2002) four C’s of mental toughness (commitment, challenge, control, and confidence) as a theoretical framework. The current study aims to explore physiological aspects of mental toughness through cortisol, a stress hormone that is released as an internal reaction to some type of threat occurring externally to the body (Kottler & Chen, 2011). The relationships between mental toughness and other personality constructs (self-efficacy and grit) were also explored. Sixty-three participants were recruited from a small liberal arts college to take a questionnaire consisting of the Dispositional Resilience Scale (DRS; Bartone, 2007), the General Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995), and the Grit Scale (Grit; Duckworth, Peterson, Matthews, & Kelly, 2007). Participants then engaged in both a physically and cognitively stressing task. Saliva samples were taken to assess cortisol levels at the beginning and end of the study. There was a significant negative correlation between reported stress change and cortisol change \((r = -.257, p < .05)\). There was a positive correlation approaching significance between control and change in cortisol \((r = .240, p = .062)\). Findings show that those who produced more cortisol, self-reported less stress and had a greater feeling of control of their lives. The study’s findings may suggest that mental toughness is the ability to alter the perception of stress regardless of the sensation.

Keywords: Mental Toughness, Cortisol, Stress, Self-Efficacy, Grit
Understanding Mental Toughness and Stress: The Role of Cortisol

Mental toughness research stems from an interest in understanding how two people of the same skill level, same amount of experience, and similar developmental backgrounds could react to pressure and stress, with one succumbing to the pressure and poorly performing while another thriving under that stress and succeeding (Clough & Strycharczyk, 2012). While specific definitions of mental toughness vary, all hold commonality in describing the attitudes, behaviors, cognitions, and emotions that allow an individual to reach goals and succeed when facing obstacles, which cause some type of stress. A person who is mentally tough is seen as sustaining performance (Cowden, Anshel, & Fuller, 2014), achieving goals (Hardy III, Imose, & Day, 2014), persevering (Fourie & Potgieter, 2001), and thriving (Gucciardi, Gordon, & Dimmock, 2008) in the face of stressful, high pressure, difficult situations that may include distractions directly related to or outside of the environment. Mentally tough individuals are described as having high self-esteem and self-confidence (Crust & Clough, 2005; Jones, Hanton, & Connaughton, 2002), being highly self-motivated and believing that their actions directly affect the outcomes in their life, therefore having an internal locus of control (Crust & Azadi, 2010). Research shows that mental toughness correlates positively with optimism and negatively with pessimism (Nicholls, Polman, Levy & Backhouse, 2008). In relation to other aspects of personality, those who are mentally tough are hopeful, adaptive, coachable, and perfectionistic. They also demonstrate good coping skills when handling stressful, challenging environments and situations (Drees & Mack, 2012; Weissensteiner, Abernethy, Farrow, & Gross, 2012).
Mental toughness is a widely accepted concept in athletics, by coaches and athletes, but is now used to describe people in a variety of social domains (Hardy, Bell, & Beattie, 2014). As mental toughness is becoming a part of the vocabulary in the realms of business, the military, the performing arts, and rehabilitation programs (Guillén & Laborde, 2014; Hardy et al., 2014; Levy, Polman, Clough, Marchant & Earle, 2006), it is important that a clear definition exists and the effects on the mind and body are understood. Despite the importance of mental toughness as a construct, it remains controversial whether mental toughness acts as a personality characteristic or a psychological factor that is environment specific. Research supports the notion that mental toughness is dependent upon situational factors such as stress, pressure, and adversity (Gucciardi, et al., 2008; Guillén & Laborde, 2014). Nevertheless, the literature also supports mental toughness as a dispositional trait that functions the same as other aspects of personality (Clough & Strycharczyk, 2012; Cowden et al., 2014; Hardy, et al., 2014; Jones et al., 2002). It may be that mental toughness is a multi-dimensional construct in which one facet of mental toughness is dispositional, while another is environmental, suggesting that both may exist and coincide in their effects on the person.

Previous related research has shown that mental toughness is correlated with endurance in that those who showed more physical endurance self-reported higher levels of mental toughness (Crust & Clough, 2005). It is known that mental toughness relates to performance level, so it is expected that there would be a similar connection between mental toughness and physiological measures. Research shows that mental toughness is affiliated with pain tolerance and coping with problems that are task-oriented (Crust & Clough, 2005). Mental toughness may increase the ability to cope with pain as well (Crust & Clough, 2005; Levy et al., 2006).

Theories of Mental Toughness
Much of the understanding of mental toughness derives from qualitative research in which athletes and coaches from various sports and competition levels contributed their perceptions of mental toughness (Arthur, Fitzwater, Hardy, Beattie, & Bell, 2015; Hardy et al., 2014). Across multiple studies, the same themes in defining mental toughness consistently appear. Jones, Hanton, and Connaughton (2002) developed a theory of mental toughness based off qualitative research that includes twelve characteristics of the construct. These characteristics are 1) unshakable self-belief in one’s ability to achieve goals in competition 2) unshakable self-belief that one has qualities and abilities that are unique in a way to make one better than everyone else 3) the ability to come back from set-backs due to motivation to succeed 4) an insatiable desire and internalized motives (internal locus of control) 5) thriving on pressure 6) knowing that anxiety in competition is inevitable and that one has the skills to cope with it 7) not negatively affected by another’s good or poor performance 8) doesn’t let personal/life issues distract one from the task at hand 9) the ability to turn on focus for a sport, and also turn it off 10) not distracted by task/competitive specific distractions 11) can push aside physical or emotional pain when present and maintain proper technique and high performance and 12) have psychological control during unexpected and uncontrollable events that occur in competition. According to this theory, when someone possesses these twelve characteristics they are considered mentally tough. Although all of these statements are accurate portrayals of mental toughness, when asked, athletes tended to emphasize some of the aspects over others; those considered important varied upon the level of athletic competition or the specific sport played by the athlete.

Clough, Earle, and Sewell (2002) created a more succinct theory of mental toughness that has aspects that apply to all types of people in a variety of fields. Many of the definitions in the
current literature describe hardiness in similar terms to mental toughness such that the hardy personality prefers to work in challenging environments (Clough & Strycharczyk, 2012), see stressful situations as opportunity for growth, and have the motivation and ability to maintain a level of high performance in stressful environments (Gucciardi et al., 2008). The three C’s of hardiness is the most recognized theory to describe this personality construct, consisting of commitment, control, and challenge. Clough, Earle, and Sewell (2002) added confidence, in addition to the three C’s, to create a new theory of mental toughness. Confidence was seen as an important factor in performance and therefore beneficial to the athlete. The addition of confidence helped create the theory used most commonly in the research of mental toughness (including the present study), the four C’s of mental toughness (Clough, Earle, & Sewell, 2002).

Clough and Strycharczyk (2012) have described these four components in depth in their research. Control is the knowledge that one has control of their life, in terms of the work they do, the tasks they complete, and the environment they are a part of. Two facets of control are described. The first being emotional control, the ability to cope with anxiety and hide emotions from others. The second, life control, is the feeling that actions chosen have a large impact on life. Challenge, according to the theory, implies that one seeks out challenges and sees them as opportunity for self-growth. Those who embrace challenge also tend to succeed in new environments, as opposed to those who may be fearful or anxiety-struck by a large change in life. Commitment refers to one’s ability to keep a promise to their self and to others. Those with strong commitment usually work well with deadlines. The last component, and what separates mental toughness from hardiness, is confidence. Similar to control, there are two aspects to confidence: confidence in abilities and interpersonal confidence. Confidence in abilities exudes when individuals believe in themselves and in their ability to complete work and tasks; they are
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not affected by setbacks, and keep pushing forward through challenging experiences. They use methods of self-validation to feel worthwhile and remain optimistic. Interpersonal confidence describes the way one is not intimidated by large groups of people or by awkward people. They are usually more assertive and may stand out in a group. A movement from qualitative research to quantitative research has occurred now that a solid understanding of the concept exists (Arthur et al., 2015; Hardy et al., 2014).

Quantitative research so far has expanded knowledge of mental toughness and how it differs from person to person. It has been found that athletes that are more skilled or talented, usually self-report higher levels of mental toughness (Weissensteiner et al., 2012). Similarly, when non-athletes were compared to athletes on aspects of mental toughness (e.g. hope, optimism, perseverance, resilience), athletes scored higher on every scale (Guillén & Laborde, 2014). It is unknown whether mental toughness develops with age or with experience, however a strong positive correlation exists between age and mental toughness, along with level of competition (in athletics or level of position in the business world) (Drees & Mack, 2012; Marchant, Polman, Clough, Jackson, Levy, & Nicholls, 2009). For example, those competing at the high school level in athletics or in an entry level position in the workplace showed lower levels of mental toughness than those competing at the Olympic level or in an executive position. However, there is evidence for the stability of mental toughness as an aspect of one’s self.

Measures of mental toughness show that there is no change throughout a single competitive season; mental toughness does not differ from game to game (Drees & Mack, 2012). One who is mentally tough will remain mentally tough. Some suggest that mental toughness may be developed similarly to resilience in that as we experience more challenge, our strength against that adversity grows (Arthur et al., 2015; Clough & Strycharscyk, 2012; Crust & Azadi, 2010;
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Guillén & Laborde, 2014). The coaching styles that one trains with, in the lens of athletics, may help to develop or hinder the growth of mental toughness (Cowden et al., 2014). Mental toughness may be vital in order to train at one’s peak performance level (Clough & Strycharczyk, 2012), and therefore is important to examine in future research.

**Mental Toughness and Personality**

The relationship between mental toughness and other personality traits has been explored. The five factor model of personality is one of the most consistently researched theories of personality. It describes five broad factors that have been consistently found to describe personality across cultures (John and Srivastava, 1999). In regards to the five factor model, mentally tough people are generally high in conscientiousness, extraversion, and agreeableness and show low levels of neuroticism (Delaney, Goldman, King & Nelson-Gray, 2015).

Additionally, mental toughness has similar qualities to resilience and grit (Arthur et al., 2015), personality constructs associated with performance and success. Resilience is the ability to bounce back after a trauma or stressor (Connor and Davidson, 2003), as well as being a very adaptive trait, and like mental toughness, may increase with age and experience (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). However, resilience is the ability to recover after the stressor or trauma has occurred; it is the ability to come back fighting for the next effort. Mental toughness, on the other hand, is the ability to adapt during the stressor in order to perform at a high-level in the moment.

Another construct that may be related to mental toughness is self-efficacy, a belief in that one can cope with struggles that may arise during new and difficult tasks. A perceived sense of self-efficacy has been associated with optimism, a high level of perseverance and goal attainment. Additionally, self-efficacy, like resilience, plays a role in the ability to recover from
setbacks (Schwarzer & Jerusalem, 1995). The mental toughness constructs of control and challenge, specifically, appear to be similar to self-efficacy in the ability to embrace a challenge and control the coping that occurs.

Grit appears to be closely related to mental toughness in that it is the ability to persevere. A gritty individual is one who is able to sustain efforts towards a long-term goal and stay passionate about pursuing that goal (Kelly, Matthews, & Bartone, 2014). Studies of grit focus on those who had goals and tasks that lasted months, or even years. Although this construct of grit is the ability to focus on a goal and persevere through hardships to attain that goal, the present study hypothesizes that grit is something different than mental toughness. This belief is held due to grit being about perseverance over an extended period of time, where mental toughness appears to be the perseverance through a short-term stressor so as not to disrupt performance on one particular task.

**Mental Toughness and Physiology**

*Stress Physiology*

Stress is an internal reaction that occurs within the brain to some type of threat or stressor that is generally occurring externally to the body (Kottler & Chen, 2011). The experience of stress has been shown to negatively affect performance, ability to concentrate, and decision making skills (Dias-Ferreira et al., 2009). In order to combat against this stress, there are two physiological systems that work to minimize the body’s initial reaction to the stress. Stress, along with the chemicals released in the body when a stressor is recognized, acts as a way to keep a person safe, to let them know whether to prepare to fight off the stressor or flee from it. Initially when a stressor is recognized, the hypothalamus stimulates the adrenal medulla which releases epinephrine and norepinephrine almost instantaneously. These two hormones ignite the
sympathetic nervous system response, the evolutionary reaction to stress where the organism is prepared physiologically to run away or battle the stressor. However, if the stressor is more than momentary, a second response begins. In this case, the hypothalamus triggers the anterior pituitary gland to release an adrenocorticotropic hormone. This signals the adrenal cortex to release a number of glucocorticoids, the most prominent in humans being cortisol. Cortisol is a stress hormone used to cope with longer lasting stressors and reduces the effects of the initial shock response that is experienced. When cortisol enters the bloodstream, it has many effects on the body. It increases the supply of blood glucose to the body and the brain for use in the fight or flight reaction, it turns off all systems that are unnecessary in dealing with the threat/stressor, it shuts down the reproductive system, and it inhibits the immune system. Although cortisol is helpful in handling stress, too prolonged of a stress response or too much in the body has been implicated in a host of severe health issues, such as cardiovascular disease, cancer, depression, internal bleeding and ulcers (Sapolsky, 2004). Too much stress is quite harmful to the body as it takes a toll on many structures within, however stress in moderation can act as a motivator. However, a little bit of stress will heighten focus and performance, help one respond to a threat, and act as an energizer (Kottler & Chen, 2011).

Mental Toughness and the Body

It has been suggested that mental toughness may have some sort of “buffering effect (resistance resource), given differences in how demanding conditions are cognitively appraised or how situations are dealt with, i.e., exerting control by blocking out pain” (Clough et al., 2002; Crust & Clough, 2005, p. 193; Gucciardi et al., 2008). Therefore, mental toughness may mitigate the negative effects of stress, enabling one to push beyond physiological and psychological hardship that would hinder one from peak performance. Correlations have been found between
physiological measures (such as cortisol) and performance, however how measures of mental toughness relate to those physiological measures has not been investigated empirically.

The current study aims to explore physiological aspects in relation to levels of mental toughness. This research used measures of personality traits that make up mental toughness to understand how the construct relates to cortisol levels produced when one is introduced to a physically stressing situation followed by a cognitively stressing task. Researchers believed that those who self-reported higher levels of mental toughness would show less change in cortisol from before the stressful situation and task to after, therefore showing that mental toughness relates to one’s ability to cope with pain and stress and perform at a high level.

**Method**

**Participants**

Participants were undergraduate students from a small liberal arts college. There were a total of 63 participants (14 male and 49 female). Age of participants ranged from 18-47 with the average age being 20.29. Participants varied in identification of race as well (5 Asian, 1 African American, 43 Caucasian, 7 Hispanic, and 7 mixed race). All participants were in the undergraduate program, however varied across all years (18 first years, 18 second years, 10 third years, and 17 fourth years). Participants received class credit when appropriate for completing the study.

**Measures**

**DRS.** The Dispositional Resilience Scale (DRS; Bartone, 2007) is a 15-item questionnaire that contains questions pertaining to one’s sense of commitment, control, and challenge (the three components that make up hardiness) in their life. The questionnaire is measured on a 4-point likert scale with 1 being not at all true and 4 being completely true. An example statement
from this scale is “By working hard you can nearly always achieve your goal”. In the present study, Cronbach’s alpha for the total scale was .74.

**GSE.** The General Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995) is a 10-item questionnaire created to measure general perceived self-efficacy of an individual. The questionnaire is measured on a 4-point likert scale with 1 being not at all true and 4 being exactly true. An example statement from this scale is “I can always manage to solve difficult problems if I try hard enough”. In the present study, Cronbach’s alpha for the total scale was .82.

**Grit.** The Grit Scale (Grit; Duckworth, Peterson, Matthews, & Kelly, 2007) is a 12-item questionnaire that contains questions pertaining to an individual’s level of grittiness. The scale is measured on a 5-point likert scale with 1 being not at all like me and 5 being very much like me. An example statement from this questionnaire is, “I have achieved a goal that took years of work”. In the present study, Cronbach’s alpha for the total scale was .74.

**Procedure**

Participants first signed an informed consent sheet. Next they were assigned a randomly generated ID number, utilized match saliva samples to questionnaire answers. Participant names were kept separate from the questionnaire and saliva results. Saliva was collected using commercially available salivette containers consisting of a cotton pad in an enclosed plastic tube. Participants were instructed to take the cap off of the tube and tip it back until the cotton pad fell into their mouth, then chew on the pad for 30 seconds. The pad was then placed into the plastic tube without any direct handling (i.e., they "spit" it back into the tube). The tube was put into the freezer of a small refrigerator.

Next, participants completed a questionnaire that contained a number of measures. The survey also asked demographic questions about gender, age, race, years in school, and athletic
experience. The survey was distributed using Qualtrics.

After completing the survey, participants were introduced to their physical task, which consisted of them holding their pointer and middle fingers in a bowl of water at four degrees Celsius for a total of five minutes. Participants were instructed to put their two fingers into the cold water just past their second set of knuckles. They were told that if at any point it became too uncomfortable they could pull their fingers out, however at that moment the investigator would stop the timer, wait for them to feel comfortable again, and then ask them to place their fingers back in the water for the remainder of the five minutes. Upon receiving the instructions, participants were asked to rank how confident they felt that they could hold their fingers in the cold water for the consecutive five minutes, without removing them at any point on a 5 point likert scale with 1 being not confident at all and 5 being very confident. All answers were recorded and matched with their randomly generated ID number. At this point they were asked to put their fingers in the water and the investigator started the timer. The investigator sat in the room with the participant, but did not interact with them. The participant could not see the timer during the time their fingers were in the water. If participants asked how much time was left, the investigator told them that she was not able to give that information, but she would tell them when to remove their fingers. When the five minutes were completed, the investigator told the participant to remove their fingers. At this time the participants were asked to rank how stressed they felt in that moment on a 5 point likert scale with 1 being not very stressed and 5 being very stressed. Answers were recorded.

Participants proceeded to a cognitive task, completing puzzles consisting of 16 cube blocks with varying patterns on each side. The blocks were red and black. Pictures were provided of completed puzzles and the participants were asked to match the blocks to the
pictures (See Appendix A). The participants were asked to complete the first puzzle before moving onto the next. They were also told to go in order of the puzzles presented. Each participant was presented with 17 puzzles, beginning with easier designs and progressively increasing in difficulty. A timer was set for 10 minutes. Participants were told to complete as many puzzles as possible in the 10 minutes. Again, the investigator sat in the room while the participant worked, but did not interact with the participant. At the end of the 10 minutes, the investigator counted the number of puzzles completed and recorded the results. The participant was then asked to rank their stress level in that moment on the same 5 point scale that was used after the physical task.

Next, the participants were asked to give a second saliva sample, in the same manner as the first. While the participant was chewing on the cotton pad, the investigator gave the participant a debrief in asking him/her to not discuss the study in any way until all participants were run. They were told that they would receive an email at that time giving them more details as to what the purpose of the study was and any results that may have been found (for procedural script see Appendix B). When the second saliva sample was “spit” back into the tube, the investigator put it in the freezer of the small refrigerator. At the end of each day, the saliva samples were taken to an industrial freezer at -22 degrees Celsius to be kept until all participants had been run through the study, and until assayed for cortisol.

Cortisol concentration was determined through a cortisol enzyme immunoassay kit (EIA) (Arbor Assays Inc., Ann Arbor, Michigan, USA). Saliva samples were diluted 1:4 with the supplied Assay Buffer prior running in the assay. The assay was carried out as outlined by the manufacturer. Each sample was run in duplicate to allow accurate determinations of cortisol concentrations. The 96-well plate was read using a spectrophotometer at 495 nm wavelength to
provide optical density measurements. Final concentrations were calculated using raw absorbance data interpolated from the standard curve generated with GraphPad Prism version 6 (GraphPad Software Inc., La Jolla, California, USA). The two concentrations from a single participant were averaged together to create an accurate number.

Results

Descriptive analyses were run to identify means and standard deviations of each scale. (see Table 1). Pearson product moment correlations were utilized to analyze relationships between measures of the DRS, the GSE, stress change, and cortisol change. There was a significant negative correlation between reported stress change and cortisol change ($r = -0.257, p < 0.05$) (see Figure 1). There was a positive correlation approaching significance between control and change in cortisol ($r = 0.240, p = 0.062$) (see Figure 2). There were significant positive correlations between the control and commitment totals ($r = 0.420, p < 0.01$), control and hardiness ($r = 0.722, p < 0.01$), challenge and hardiness ($r = 0.697, p < 0.01$), and commitment and hardiness ($r = 0.670, p < 0.01$). A significant positive correlation existed between grit and commitment ($r = 0.281, p < 0.05$), while a significant negative correlation existed between grit and reported stress change ($r = -0.273, p < 0.05$). There were significant positive correlations between self-efficacy and grit ($r = 0.309, p < 0.05$), commitment ($r = 0.366, p < 0.05$), control ($r = 0.409, p < 0.01$), hardiness ($r = 0.453, p < 0.01$), and change in cortisol ($r = 0.261, p < 0.05$). See Table 2 for correlation matrix. No significant correlations were found between any of the scales and the first cortisol sample or the second sample.

The participants were split into two groups based on whether their cortisol level increased or decreased while they were in the lab. Independent t-tests showed that the people who increased in their cortisol level self-reported significantly less change in stress ($t = 2.000, df =$
59, \( p = .05 \) (see Figure 3) and a significantly higher level of control (\( t = -2.012, \text{df} = 59, p < .05 \)) (see Figure 4).

A simple linear regression was calculated to predict grit based on each of the four C’s of mental toughness. No significant regression equation was found (\( F(4, 15) = 1.296, p = .284 \), with an \( R^2 \) of .092. Another simple linear regression was calculated to cortisol change based on grit and also based on control. No significant regression equation was found for either of these (\( F(2,55) = 2.510, p = .091 \)), with an \( R^2 \) of .084.

**Discussion**

The purpose of this study was to explore the relationship between psychological indicators of mental toughness and physiological indicators. The results show that those who have a greater internal sense of control (through the DRS control facet and self-efficacy) reported lower stress levels throughout the study. This aligns with expectations and the hypothesis in that those higher in mental toughness (through their level of control) would report less stress. Those same individuals who reported feeling less stress, during the physical and cognitive task, were expected to produce less cortisol, as the body was not expected to be triggered to produce cortisol, due to not perceiving a threat. However, the findings show that the opposite occurred. Those who self-reported less stress, produced more cortisol during the time of the study. This lack of support for the hypothesis may be explained by an increased focus on the negative effects of cortisol during hypothesis creation. However, the positive, adaptive features of cortisol in limited amounts must not be overlooked, as the findings of this study have shown.

To make sense of the seemingly contradictory findings of those who reported less stress being those who produced more cortisol, it is important to understand that cortisol is adaptive when in the body for a short period of time (Sapolsky, 2004). Cortisol works to enable the
release of stored glucose, providing the body with energy. The energy released aids in one handling a stressful occurrence. This process is adaptive as long as the cortisol does not remain in the body for a prolonged period of time. However, when cortisol is continually produced and stays in the body, it will begin to break down other vital organs in the body. This can lead to a multitude of health issues, which are often times accompanied by psychological difficulty (Sapolsky, 2004). The level of cortisol produced, along with the duration of cortisol production in the body depends on an individual’s perception of a stressor. As previously mentioned, stress is an individual’s perception of a possible threat in the environment. The same stimulus may evoke two different reactions in two different people based on their own perception of the stimulus as threatening, or not. The study’s findings may suggest that mental toughness is the ability to alter the perception of stress regardless of the sensation.

It is possible that mental toughness enables one to perceive this stress as something that they can control. Of the four C’s of mental toughness, control was the aspect most related to change in cortisol. Those who produced more cortisol had a significantly higher level of control than those who decreased in cortisol while they were in the lab. Additionally, those who produced more cortisol reported feeling less stress. This may be due to an adaptive use of cortisol, enabling the body to use stored energy as a way to perceive less stress. Also, a person who has a high sense of control may be able to efficiently work through the stressor due to their adaptive cortisol use, and then quickly deem an event as no longer stressful. At this point the body would suppress the cortisol production, allowing a return to its baseline level. This would inhibit the long-term negative effects that can follow increased cortisol. On the other hand, those who do not feel in control, may not be able to end the stressful situation as easily or as
efficiently. If this is the case, these individuals would produce more cortisol, for a longer period of time, and put themselves at greater risk for bodily damage and mental illness.

Two types of control exist: emotional control and life control (Bartone, 2007). Emotional control is the ability to maintain and cope with stress and anxiety, while life control is the mindset that personal actions affect outcomes. Both of these constructs are represented in the control scale of the DRS and both logically fit into the theory of mental toughness. Being able to control emotional intensity may help to minimize negative emotions, which in turn may allow one to see their actions as more impactful. If this occurs, one would be able to sustain performance, therefore being mentally tough. This aligns with previous research proposing that mentally tough people have good coping skills (Dress & Mack, 2012) and have an internal locus of control (Crust & Azadi, 2010).

Another way to look at internal feelings of control is through self-efficacy, as it is the ability to feel in control during difficult and stressing experiences (Schwarzer & Jerusalem, 1995). Bartone’s (2007) definition of life control appears to be similar to self-efficacy as well. Findings show that self-efficacy has a positive relationship to cortisol change, as individuals produced more cortisol they also reported having greater self-efficacy. This is a similar relationship to that of cortisol change and psychological control. As would be expected, self-efficacy is highly correlated with that control measure as well. This supports the notion that self-efficacy is a measure of one’s perception of their internal control, similar to the idea of an internal locus of control.

Self-efficacy also showed a positive relationship with grit in these findings. However, grit and control were not significantly related. Due to the lack of significance in the facets of mental toughness being able to predict grit, findings support the theory that grit is a different construct
than mental toughness. This disparity of a connection between grit and control, while both relate in similar manners to self-efficacy, may mean that it is adaptive to have both in life. As self-efficacy aligned with the adaptive cortisol use discussed previously, it appears that self-efficacy is an important factor in coping with stress. Additionally, grit and control seem to both align with self-efficacy, however their lack of connection to each other suggests that they are two different constructs. Control may be a key piece to being mentally tough, in that it allows one to instinctually take control of a short-term stressor. However, one may need to relinquish some of that control in instances that arise as barriers to their long-term goal in order to be gritty. Past research identifies a difference between the immediate, impulsive actions and “those that encourage actions aligned with more distal goals” (Duckworth & Steinburg, 2016, p.33). It may be that in order to be overall psychologically healthy, one needs a balance of grit and mental toughness. Grit may be the necessary trait that allows an individual to persevere towards the long term goals, while understanding those things that are out of their control; it may save one from attempting to take control of every aspect of their life, even those pieces that are absolutely out of their control, like the actions of others. Mental toughness may be our ability to perceive total internal control during immediate stressful and threatening situations and environments, which allows one to move through a barrier in order to stay on the path towards the ultimate long-term goal. These findings suggest that a psychologically healthy individual will have a balance of grit and mental toughness through different experiences in their life. Also, the psychologically healthy people would adaptively use cortisol to handle stress, allowing them to be physiologically healthy as well.

Future research should continue to explore the construct of mental toughness and how it differs from grit, while also understanding how the two constructs may work in tandem. It is also
important to understand how to develop mental toughness in young students and athletes, and whether it is a part of personality that can be learned or if it is an innate feature. If mental toughness is a learned trait, and it possible to develop, teachers, coaches, mentors, and parents would be able to build this in their children. The development of mental toughness could also be used in rehabilitation programs, coinciding with the other mental and physical programs that exist today (Guillen & Laborde, 2014). If there were more mentally tough people in the world, that also had a proper balance of grit, there would be less fighting the harmful effects that stress and cortisol can cause. There may be less mental illness as a result as well. More people would be able to adaptively use their cortisol production by having a greater belief in their ability to control their environment. Future research may also want to explore if the two facets of control (emotional and life) are significantly different, and if one may be more adaptive and important to develop than the other.

In reproducing this study, researchers may want to add a competitiveness measure as a way to assess this as a confounding variable. It would also be helpful to get a third cortisol sample as well to determine if those high in mental toughness are able to control and diminish the stressor in a shorter time period than those who may not be as mentally tough. As mentioned earlier, the ability to return to a baseline level after the stressor has ended may be the pivotal understanding of what it means to be mentally tough.

This study must be reviewed in light of limitations. One limitation of this study is the limited number of participants due to the restricted recruitment of college students. A larger sample size, and a more diverse population in gender and age, may have led to more significant findings. There is a strong possibility of stressors outside of the lab setting affecting participants cortisol levels and feelings of stress. The study lacked in its use of other psychological and
physiological signs of stress throughout the varying tasks. It is necessary to understand that the physical and cognitive tasks in the study may not have been stressful for everyone in the same way. More ways of measuring stress, along with more frequency in using those measures, may have given a better understanding of what the participants were experiencing, mentally and physically. The competitive aspect of individuals may have confounded the tasks of the study as well.

Although there were weaknesses within the study, these findings further the understanding of mental toughness. The relationship between mental toughness and cortisol, previously unknown, has now been seen to reflect the adaptive properties of the cortisol release system in the body and how it may work with this psychological construct. The findings show evidence for a relationship between grit and mental toughness, which will lead to further exploration of both concepts and their relationship with the physiological functions of the human body. This knowledge will help to better understand the mind-body connection and how it may be possible to prevent and cure disease, physical and mental.
References


Table 1

Means and Standard Deviations for each Scale within the Study

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>12.56</td>
<td>1.92</td>
</tr>
<tr>
<td>Challenge</td>
<td>7.19</td>
<td>3.00</td>
</tr>
<tr>
<td>Commitment</td>
<td>10.41</td>
<td>2.40</td>
</tr>
<tr>
<td>Confidence</td>
<td>4.13</td>
<td>0.78</td>
</tr>
<tr>
<td>Grit</td>
<td>43.64</td>
<td>5.92</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>31.40</td>
<td>3.77</td>
</tr>
<tr>
<td>Change in Cortisol</td>
<td>0.13</td>
<td>0.84</td>
</tr>
<tr>
<td>Change in Stress</td>
<td>0.82</td>
<td>1.12</td>
</tr>
</tbody>
</table>
Table 2

Correlations of Measures in Survey and Cortisol and Stress Change

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cortisol Change</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Self-efficacy</td>
<td>.261*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. Grit</td>
<td>.144</td>
<td>.309*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Commitment</td>
<td>.045</td>
<td>.366*</td>
<td>.281*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Challenge</td>
<td>.084</td>
<td>.162</td>
<td>.035</td>
<td>.125</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6. Control</td>
<td>.240</td>
<td>.409**</td>
<td>.165</td>
<td>.420**</td>
<td>.237</td>
<td>-</td>
<td></td>
<td></td>
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<tr>
<td>7. Confidence</td>
<td>.002</td>
<td>.115</td>
<td>.104</td>
<td>.092</td>
<td>.151</td>
<td>.000</td>
<td>-</td>
<td></td>
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<tr>
<td>8. Hardiness</td>
<td>.150</td>
<td>.453**</td>
<td>.212</td>
<td>.670**</td>
<td>.697**</td>
<td>.722*</td>
<td>-.099</td>
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<tr>
<td>9. Stress Change</td>
<td>-.257*</td>
<td>-.169</td>
<td>-.273*</td>
<td>.006</td>
<td>-.090</td>
<td>-.237</td>
<td>.075</td>
<td>-.103</td>
</tr>
</tbody>
</table>

*Note. ** p < .01, two-tailed; * p < .05, two-tailed*
Figure 1. Significant negative correlation between change in cortisol in participants and change in reported stress levels ($r = -.257, p < .05$).
Figure 2. Positive correlation approaching significance between change in cortisol in participants and level of control based on the Dispositional Resilience Scale (r = .240, p > .05)
Figure 3. Independent t-tests showed that the people who increased in their cortisol level self-reported significantly less change in stress than those who decreased in cortisol ($t = 2.000$, df = 59, $p = .05$).
Figure 4. Independent t-tests showed that the people who increased in their cortisol level self-reported a significantly higher level of control than those who decreased in cortisol ($t = -2.012$, $df = 59, p < .05$).
Appendix A

The puzzles used as the cognitive stressor during the procedure.
Appendix B

Lab Script

**Phase 1**

Please take a moment to read over this consent form. If you agree and consent to participate in this project please sign at the bottom. Also if you are participating in this study for class credit, please designate which class by circling it, or if not listed write it in.

Here is your randomly generated ID number. This will ensure your anonymity throughout this project. Please hold onto these throughout your time in this space. You can place the first one on the bottom of your consent form. The second goes on this tube, and please hold onto the third, you can place it on your shirt or pants and we’ll ask you for it later in the study.

This is the tool used to collect saliva. Please place your second ID label on this tube. In just a moment, take the cap off the lid and tilt the tube back so that the material falls into your mouth. Most importantly, do NOT touch the material. Chew on the material for 30 seconds and then spit it back into the tube, again WITHOUT touching it.

This survey should take you approximately 15-20 minutes. I am going to shut the door behind you. If you have any questions, please come out and ask. When you finish the survey lightly knock on the door or the window and we will come get you to move onto the next phase of the study.

(Upon completion of the survey, and hearing the knocks, bring participant into other room to begin next phase OR move into the waiting area if another participant is still completing the second phase of the study)

**Phase 2**

What is your ID number? *(place in spreadsheet)*

Please set your cell phone to the side of the table and refrain from using it for the remainder of the study.

In just a moment, I am going to ask you to hold your pointer and middle finger, like so *(demonstrate)*, in this bowl of water for 5 minutes. The water should go up to your second set of knuckles or until your fingers touch the bottom of the bowl. If it at any point it becomes too uncomfortable, you may remove your fingers from the water. However, when you take your fingers out I will stop the clock, give you a few moments to feel comfortable again and ask you to put your fingers back in the water to complete the rest of the 5 minutes. On a scale of 1 to 5, how confident are you that you can hold your finger in this water for the consecutive 5 minutes, with 1 being not confident, and 5 being very confident? *(Record confidence number in spreadsheet)*
Although I will be sitting in the room with you during this procedure, we will not engage with one another while your fingers are in the water.

Please begin.

(Record time kept in in spreadsheet. Also record if they take their fingers out at any point and at what time they took their fingers out.)

You can now take your fingers out of the water. Here is a paper towel to dry your hand off. Now, on a scale of 1 to 5, how much stress are you feeling in this moment, with 1 being not very stressed, and 5 being very stressed?

(Record in spreadsheet)

The next portion of the study involves these blocks. You must match the blocks to the pictures on this set of cards. Please complete them in order. Once you have completed one puzzle, dump the blocks and begin the next. I want you to complete as many puzzles as possible in the next 10 minutes. I am going to set this timer, and when you hear it ring you must stop working.

Begin.

Stop working. How many puzzles did you complete?

(Count number of cards completed out loud. Record number of puzzles completed)

On the scale of 1 to 5, how much stress are you feeling in this moment?

(Record in spreadsheet)

Here is another tube, please place your last label on this tube. Again, tilt the tube so that the material falls into your mouth and chew on it for 30 seconds. Remember, do not touch the material.

DEBRIEF: Thank you for your time today. I ask that you DO NOT tell anyone anything about this study. It is vital the procedure remain confidential until the end of the study. I will send you an email explaining the details of the study and a summary of the results upon completion of the project. Again thank you, and please do not give details of this project to anyone else.