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Gritty people try harder: Grit and effort-related cardiac autonomic activity during an active coping challenge ☆

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ABSTRACT

Grit, a recently proposed personality trait associated with persistence for long-range goals, predicts achievement in a wide range of important life outcomes. Using motivational intensity theory, the present research examined the physiological underpinnings of grit during an active coping task. Forty young adults completed the Short Grit Scale and worked on a self-paced mental effort task. Effort-related autonomic nervous system (ANS) activity was assessed using impedance cardiography, which yielded measures of sympathetic activity (pre-ejection period; PEP) and parasympathetic activity (respiratory sinus arrhythmia; RSA). Multilevel models revealed that people high on the Perseverance of Effort subscale showed autonomic coactivation: both PEP and RSA became stronger during the task, reflecting higher activity of both ANS divisions. The Consistency of Interest subscale, in contrast, predicted only weaker sympathetic activity (slower PEP). Taken together, the findings illuminate autonomic processes associated with how "gritty" people pursue goals, and they suggest that more attention should be paid to the facets' distinct effects.

1. Introduction

Why do some people try so much harder than others? The role of individual differences in effort is a classic problem in motivation science (Atkinson, 1964). Recently, researchers have proposed a trait known simply as *grit*, which represents "perseverance and passion for long-term goals" (Duckworth et al., 2007, p. 1087). The growing literature on grit shows that it predicts an impressive set of real-world markers of motivation and perseverance. Gritty adults have higher educational attainment and higher college GPAs (Duckworth et al., 2007), gritty children perform better in the National Spelling Bee (Duckworth et al., 2007), gritty military cadets are more likely to graduate from an elite military academy (Duckworth et al., 2007; Maddi et al., 2012), and gritty teachers foster better academic performance in their students (Duckworth et al., 2009). Grit predicts success in part by promoting self-control, thus allowing people to persist in repetitive, tedious, or frustrating behaviors that are necessary for success (Duckworth et al., 2011).

To date, no psychophysiological studies have examined how individual differences in grit manifest themselves in biological mechanisms of effort and motivation. Given the role of grit in fostering real-world success, it is important to understand the biological processes that allow gritty people to achieve long-range goals. Motivational intensity theory (Brehm and Self, 1989), a general model of how people regulate effort (Gendolla et al., 2012; Wright, 1996; Wright and Kirby, 2001), offers a natural platform for developing predictions about how grit influences effort-related physiology. Motivational intensity theory proposes that effort is a function of two factors: the importance of success and the perceived difficulty of attaining the goal. The importance of success defines how much effort people are willing to expend; the difficulty of attaining it defines actual effort.

How might grit affect effort? According to motivational intensity theory, a trait can affect effort by making goals more or less important or by making achieving the goal seem more or less difficult. We expect, given theorizing about grit, that grit influences effort primarily via the importance pathway. Many traits have been shown to affect effort by affecting the importance of success (e.g., Capa and Audiffren, 2009; Capa et al., 2008; Silvia et al., 2011b). When a goal is more valuable, meaningful, or relevant to the self-concept, people are willing to expend more effort when necessary (Gendolla and Richter, 2010). Research on grit indicates that people high in grit are more passionate about their goals and more dedicated to accomplishing them (Duckworth et al., 2007), so it seems reasonable that the importance of success—and hence the level of potential effort—should be higher for gritty people.

Fortunately, motivational intensity theory offers a robust set of paradigms for illuminating the factors underlying effort, so it is easy to evaluate whether grit affects effort by making goals more important. One way to determine if higher success importance is involved is to analyze effort for unfixed-difficulty tasks (Wright et al., 2002). Also known as self-paced, piece-rate, and do-your-best tasks, unfixed tasks allow

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people to work at their own pace and hence achieve as much or as little as they wish. For unfixed tasks, motivational intensity theory predicts that effort is solely a function of importance (Wright, 2008), a pattern that many experiments have found (e.g., Gendolla et al., 2008; Silvia, 2012; Silvia et al., 2011a).

In the present research, we examined how grit affected cardiac autonomic activity during an active coping challenge. Grit has two facets—Perseverance of Effort and Consistency of Interest, hereafter Perseverance and Consistency—and we were interested in whether these facets differentially affected the physiological mobilization of effort. Perseverance reflects commitment and effort toward one's goals; it is measured with items such as "I finish whatever I begin." Consistency reflects focus and dedication to a small set of important goals; it is measured with items such as "New ideas and projects sometimes distract me from previous ones" (reversed).

Despite the important conceptual differences between these facets, most published work on grit has used the total score and has not reported subscale-specific effects. The subscales correlate highly ($r = .59$; Duckworth and Quinn, 2009) but not so highly to preclude distinct effects. For example, Perseverance more strongly predicted middle- and high-school students' GPAs and extracurricular activities, and Consistency more strongly predicted making fewer career changes during adulthood (Duckworth and Quinn, 2009). Regarding effort on a novel task, one could foresee potential differences. Perseverance should predict higher effort due to a tendency to take goals seriously and to try hard, whereas Consistency may not—novel goals that fall outside the small sphere of central goals might be seen as unimportant.

Effort was quantified in terms of cardiac autonomic activity. Our primary outcome was the cardiac pre-ejection period (PEP; the systolic interval between ventricular depolarization and the opening of the aortic valve), which is commonly used to measure beta-adrenergic sympathetic impact on the heart (Kelsey, 2012; Richter and Gendolla, 2009). Research on motivational intensity theory typically measures how the sympathetic division of the autonomic nervous system (ANS) influences cardiovascular activity (Wright & Gendolla, 2012). Sympathetic activity is a reliable indicator of motivational engagement in contexts requiring "active coping" (Obrist, 1976, 1981), such as when people must expend effort to attain an attractive goal or reward. Most past research has used systolic blood pressure (SBP) to quantify sympathetic impact during effortful engagement (Gendolla et al., 2012; Wright, 1996). In recent research and the present study, impedance cardiography is used to assess sympathetic influences on the heart more directly (Kelsey, 2012).

Sympathetic cardiac processes are more central to effort and motivational intensity theory, so PEP is our primary measure of interest. We also measured, as a secondary and exploratory outcome, parasympathetic influences on the heart. Respiratory sinus arrhythmia (RSA; high-frequency variability in heart rate as a function of respiration) was used to measure parasympathetic activity. A large literature supports PEP and RSA as markers of the activity of the sympathetic and parasympathetic ANS divisions (e.g., Berntson et al., 1993, 1994, 2008; Cacioppo et al., 1994; Schächinger et al., 2001).

For our purposes, RSA was a secondary but interesting dependent variable: it isn't a standard measure of effort during appetitive tasks, but it can illuminate emotional control and "cooling" in response to stress (Segerstrom et al., 2012). Measuring both sympathetic and parasympathetic influences is worthwhile because the divisions of the ANS can operate independently, jointly, or reciprocally (Berntson et al., 1991; Koizumi and Kollai, 1992; Paton et al., 2005). Moreover, some recent applications of motivational intensity theory have suggested measuring RSA, if only to provide additional information about autonomic processes during goal engagement (Richter, 2010). One example comes from recent work on how appraisals of goal relevance and goal conduciveness influence the relative activation of the sympathetic and parasympathetic branches (Kreibig et al., 2012). When an event was appraised as both relevant and conducive to a goal, people showed higher sympathetic and parasympathetic activation, which suggests a profile of heightened motivational engagement in response to an opportunity for reward and achievement (cf. Kreibig et al., 2010). Thus, one can see bridges between how goal-related appraisals affect autonomic activity (Kreibig et al., 2012) and motivational intensity theory's historical interest in active coping processes (Wright, 1996). If both sympathetic and parasympathetic autonomic divisions reflect the cognitive appraisals involved in how people evaluate goals, then it is worth measuring both when evaluating how people engage with goals.

2. Method

2.1. Participants and design

A total of 40 adults—24 men and 16 women—participated in the experiment. Participants were students in psychology courses who volunteered and received credit toward a research option or adults who responded to flyers advertising the study and received $10. Four participants were excluded, leaving a final sample of 36 people (21 men, 15 women). The sample was young ($M = 19.83$, $SD = 2.52$) and mostly European American (58%) or African American (36%). All participants provided informed consent. The experiment was approved and monitored by UNCG's Institutional Review Board.[1]

2.2. Materials and procedure

Each participant was tested individually. The sessions were conducted by a gender-matched experimenter, who explained that the study was about how mental effort was reflected in the body, particularly in the activity of the cardiovascular system. The participants completed a series of personality questionnaires and then a computer-based cognitive task requiring mental effort. The questionnaires and tasks were completed using MediaLab and DirectRT (Empirisoft, NY). After the experimenter prepped the skin with alcohol wipes and placed the electrodes, the participants sat quietly and completed demographic and personality questionnaires on the computer for approximately 10 min. During the middle of this period, 5 min of baseline readings was taken.

2.2.1. Grit scale

Grit was assessed using the Short Grit Scale (Grit-S; Duckworth and Quinn, 2009). This scale has eight items—four for Perseverance, four for Consistency—rated on five-point scales (1 = *not like me at all*, 5 = *very much like me*). Based on Cronbach's alpha, internal consistency was $\alpha = .52$ for Perseverance, $\alpha = .69$ for Consistency, and $\alpha = .74$ for the full scale. The Perseverance and Consistency subscales correlated $r = .54$ ($p < .001$), which is similar to past work ($r = .59$; Duckworth and Quinn, 2009). The scores were relatively normal: neither skewness nor kurtosis values were significant for the total scale or the subscales.

2.2.2. Parity task

After the baseline period, participants were introduced to the mental effort task. The parity task, developed by Wolford and Morrison (1980), involves presenting a word flanked by two numbers, such as "3 BENCH 8." Participants must ignore the word and decide if the two numbers have the same parity (both even or both odd) or a different parity (one even, one odd). The parity task is challenging because the

[1] People were excluded for the following reasons: one person disclosed a serious heart condition after the session; one case had poor signal quality; one male was inadvertently scheduled and run by a female experimenter; and one person was screened out due to high scores (greater than 2) on a 7-item revised version of Chapman and Chapman's (1983) "infrequency scale," a set of true/false items that capture inattentive and rapid responding (e.g., answering "false" to items like "There have been a number of occasions when I have sat in a chair" and "true" to items like "I cannot remember a single occasion when I have spoken English out loud.").