Grit, Coping, and Math Anxiety: Examining the Pathways Through Which Devotion to Long-Term Goals May Promote Student Well-Being

by

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Abstract

This study sought to determine the extent of the relationship between grit and academic coping in upper elementary school children, and whether proactive coping accounts for lower self-reported school-related internalizing symptoms in grittier students. The sample included 56 children and adolescents in Grades 4 through 6. In agreement with predictions, students who reported higher levels of grit also reported greater strategizing and commitment in response to academic challenges, strategies classified as proactive independent coping approaches. This relationship between grit and coping was mediated by affiliated increases in self-efficacy for self-regulated learning and autonomous academic motivation. Analyses also showed evidence of a significant negative indirect effect of grit on math anxiety through proactive independent coping, indicating that grittier students reported greater proactive coping which in turn was associated with lower math anxiety. Given its relationship with adaptive coping and reduced academic emotional stress, grit may constitute a factor promoting student resilience.
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*Figure 2.* Diagrammatic illustration of mediation model including grit as the predictor, proactive independent coping as the mediator, and math anxiety as the outcome. 95% percentile confidence intervals based on 5000 bootstrap samples are reported in square brackets.
1 Introduction

Resilience is dependent upon a distinct psychological profile that instills the sense of efficacy and determination necessary for individuals to surmount adversity (Mash & Wolfe, 2016). Of critical importance is the nature of one’s coping in response to challenges (Mash & Wolfe, 2016). In particular, people who thrive despite encountering hardship are characterized by their tendency to actively seek solutions to problems (Dumont & Provost, 1999). In the school context, research indicates that the use of positive academic coping strategies predicts lower student stress levels (Miquelon & Vallerand, 2006) and greater subsequent behavioural and emotional investment in schoolwork (Skinner, Pitzer, & Steele, 2016). Although there is research relating grit to student success (e.g., Duckworth & Quinn, 2009) and well-being (e.g., Meriac, Slifka, & LaBat, 2015), it remains to be determined what coping mechanisms grit is affiliated with during the elementary years, and whether these coping mechanisms in part account for the positive outcomes affiliated with this facet of personality. Therefore, the goal of the current thesis will be to investigate grit as a precursor to childhood resilience by examining its hypothesized links to coping, and in turn, math anxiety, a common emotional challenge for elementary school students (Ramirez, Shaw, & Maloney, 2018).

There is a need to focus on positive coping and resilience given that mental health is an important component of well-being (Mash & Wolfe, 2016), and evidence indicates that there was a decline in the mental well-being of youth from 2007 to 2015 in Ontario (Boak, Hamilton, Adlaf, Henderson, & Mann, 2016). For example, in a study conducted by Boak et al. (2016), the data show that the number of youth reporting poor or fair (rather than good or excellent) mental health grew significantly from 11.4% in 2007 to 16.5% in 2015. Furthermore, in 2015, nearly one third of the sample reported that during the past month, they had encountered a significant amount of stress (Boak et al., 2016). Not unexpectedly, the survey findings also suggest that the psychological distress experienced by Ontario students is increasing rapidly, with a significantly greater proportion of students experiencing either severe or moderate levels of distress in 2015 relative to 2013 (Boak et al., 2016). Evidently, there is a critical need for further research that identifies preventative factors or characteristics that will minimize the likelihood of youth developing internalizing difficulties.
Given that anxiety disorders are the most prevalent form of psychopathology amongst children and adolescents (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015), and are significantly associated with the development of future comorbid psychological difficulties (Kessler et al., 2012), anxiety represents an important target for prevention efforts. Due to the systematic constraints limiting the provision of mental health services to all youth impacted by psychological difficulties (Duncan, Boyle, Abelson, & Waddell, 2018; Flett & Hewitt, 2013), researchers have recommended a renewed focus on efforts to foster student well-being from within the school environment (Flett & Hewitt, 2013). It appears that one important contributor to anxiety in school age youth is their school performance. For example, Sweeting, West, Young, and Der (2010) found that the extent to which adolescents reported worrying about their school performance was a significant contributor to the increase in psychological distress amongst European youth from 1987 to 2006. Therefore, the anxiety that students experience in relation to their academic work represents an important area to address in research and practice.

Flett and Hewitt (2013) have argued that resilience is a critical trait to foster within young people in order to protect their mental health. Importantly, a distinguishing feature of individuals who are able to maintain their psychological well-being despite encountering factors likely to undermine it is their ability to cope effectively (Mash & Wolfe, 2016). A recently published meta-analysis examining the relationship between coping and both internalizing and externalizing difficulties demonstrated that symptoms of psychological disorders are significantly lower in children and adolescents who are able to employ adaptive coping techniques (Compas et al., 2017). One reason why some children and adolescents may use more adaptive coping mechanisms than their peers is that they have a strong and persistent desire to attain their goals. This quality has been described as “grit” by Duckworth, Peterson, Matthews, and Kelly (2007). In turn, those who report high levels of grit may then show lower levels of anxiety in response to typical academic tasks (e.g., doing a hard math problem). The present study tests this hypothesis by examining whether greater self-reported grit in upper elementary students predicts the tendency to employ adaptive coping strategies in response to academic challenges, and furthermore, whether such a coping profile mediates the hypothesized negative relationship between grit and math anxiety.
1.1 Grit

The construct of grit refers to an individual’s consistent dedication to the pursuit of their goals over time (Duckworth, Peterson, Matthews, & Kelly, 2007). Grit constitutes a distinct trait in that it is not dependent on cognitive ability (Duckworth et al., 2007) or self-control (Duckworth & Gross, 2014), and contributes to the prediction of outcomes even after accounting for conscientiousness (Duckworth et al., 2007). As conceptualized by Duckworth et al. (2007), it is a unique facet of personality that is critical to the achievements of highly successful individuals. High levels of grit are signified by the devotion of intense effort to reach goals that are not attainable in the immediate future; namely, those that require persistence through countless obstacles (Duckworth et al., 2007). More specifically, gritty individuals possess a combination of two factors: perseverance of effort and consistency of interests (Duckworth et al., 2007). They are not perturbed by challenges and put forth hard work to fulfill the objectives they have set for themselves; their focus does not waver (Duckworth et al., 2007).

1.1.1 Grit and Achievement

The majority of early research surrounding grit pertained to its relationship with achievement in a variety of domains (e.g., Duckworth et al., 2007; Duckworth & Quinn, 2009; Eskreis-Winkler, Shulman, Beal, & Duckworth, 2014). To name a few examples, gritty individuals demonstrate advantages in terms of educational success, longevity of employment, and persistence through difficult military training (Eskreis-Winkler et al., 2014). The empowering nature of the construct became evident through research demonstrating that grit does not vary significantly as a function of IQ and remains a significant predictor of achievement after the influence of IQ is accounted for (Duckworth et al., 2007). In the area of academics, there is an abundance of evidence attesting to the significant link between grit and positive outcomes (e.g., Duckworth et al., 2007; Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014). For example, individuals who possess more grit earn significantly higher grades, both in high school and at university, and persist to achieve more advanced levels of education relative to those who report lower levels of grit (Duckworth et al., 2007; Duckworth & Quinn, 2009). Likewise, children and adolescents with higher levels of grit demonstrate greater success in extra-curricular activities (Duckworth et al., 2007; Duckworth & Quinn, 2009) and have significantly greater rates of high school completion (Eskreis-Winkler et al., 2014).
One of the mechanisms through which grit promotes successful outcomes is longer durations of time spent working towards achieving goals (Duckworth et al., 2007). In particular, Duckworth et al. (2007) found that in a sample of children and adolescents competing at the Scripps National Spelling Bee, there was a positive relationship between grit and performance in the competition, a mediator of which was hours devoted to preparation. Subsequent work has shown that amongst adults, there is also a significant relationship between grit and work ethic (Meriac et al., 2015), demonstrating that across development, gritty individuals put forth the extra effort necessary to achieve the outcomes they desire.

1.1.2 Grit and Well-being

As the literature on grit has developed, researchers have introduced a new line of focus: implications for well-being (e.g., Blalock, Young, & Kleiman, 2015; Datu, Yuen, & Chen, 2018; Jin & Kim, 2017; Lucas, Gratch, Cheng, & Marsella, 2015; Meriac et al., 2015; Salles, Cohen, & Mueller, 2014; Vainio & Daukantaitė, 2016). The early evidence suggested that grit facilitates endurance through strenuous endeavours to achieve new heights (e.g., Duckworth & Quinn, 2009). Importantly, the growing body of research to be discussed next indicates that individuals possessing high levels of grit also appear to benefit from enhanced psychological well-being generally in daily life (e.g., Datu et al., 2018; Jin & Kim, 2017; Vainio & Daukantaitė, 2016), and when encountering a diverse range of challenges (e.g., Blalock et al., 2015; Lucas et al., 2015; Meriac et al., 2015; Salles et al., 2014).

Overall, individuals possessing more grit appear to have an advantage in their typical state of mind (Vainio & Daukantaitė, 2016). Vainio and Daukantaitė (2016) conducted a study with adults in which they examined the predictive utility of grit in forecasting life satisfaction and psychological well-being. They found that individuals who were more devoted to the pursuit of their long-term goals were happier with their life, more self-assured, and felt more positive about their relationships, purpose, development, and functioning. Furthermore, Jin and Kim (2017) demonstrated that grittier adults tend to have significantly fewer depressive symptoms. With regards to the mental health of youth, there is also evidence linking grit to the well-being of adolescents (Datu et al., 2018). In particular, high school students who reported having more grit experienced significantly less symptoms of psychological distress than those reporting low levels
of grit (Datu et al., 2018). Therefore, when assessed on a global level, the psychological health of gritty individuals is typically superior.

There is also research suggesting that grit fosters resilience against a wide range of long-term stressors (Meriac et al., 2015; Salles et al., 2014). A study conducted by Meriac, Slifka, and LaBat (2015) assessed the stress levels reported by university students who were working while simultaneously engaged in their studies. Importantly, the authors found that students balancing the demands of both employment and academics reported experiencing significantly less stress overall if they were higher in grit. Further evidence suggesting that the mental health of gritty students is bolstered despite long-term challenges comes from a study by Salles, Cohen, and Mueller (2014), who found that grit predicted significantly greater well-being over time amongst students engaged in the grueling task of completing a surgical residency.

Importantly, the positive relationship between grit and psychological health appears to also extend to stressful situations that are more acute in nature (Blalock et al., 2015; Lucas et al., 2015). For example, in the university context, grit represents a significant moderator of the relationship between the experience of negative life events and subsequent suicidal ideation (Blalock et al., 2015). Specifically, individuals who experience salient, unfortunate life circumstances are only at a significantly greater risk to contemplate suicide if they are lower in grit (Blalock et al., 2015). Even in artificial scenarios manufactured for research purposes, gritty individuals remain emotionally resilient despite encountering setbacks. In a study conducted by Lucas, Gratch, Cheng, and Marsella (2015), participants were assigned to experimental conditions that predetermined whether they would be told they were doing well or poorly at a math game across multiple stages. After receiving negative feedback on each consecutive session of the game, individuals who were higher in grit decided to persevere significantly more often, despite being provided with the option to quit, which was in part accounted for by their psychological reaction to the situation. In particular, gritty individuals were less emotionally upset by the negative results and maintained a more optimistic outlook on their ability to succeed at the task, which in combination mediated the link between grit and choice to proceed with the game. In combination, these findings suggest that an additional benefit of possessing grit is the ability to maintain psychological strength despite encountering threats to well-being.
1.1.3 Grit and Coping

Despite the wealth of evidence indicating a positive relationship between grit and mental health in myriad circumstances (e.g., Blalock et al., 2015; Meriac et al., 2015; Salles et al., 2014), there appears to be very little research directly examining the link between grit and specific mechanisms of coping. A study conducted by Lovering et al. (2015) provided the first evidence of differences amongst individuals in their use of distinct coping strategies as a function of grit. In a sample composed of American men beginning their training as Marines, Lovering et al. found that higher levels of grit were significantly correlated with greater use of three methods of coping: positive reframing, planning, and active coping. More specifically, the grittier the individual, the more often they reported coping by adopting a positive perspective on the stressor, devising a plan for future action, and taking initiative to address the situation. Furthermore, there was a significant negative relationship between grit and the propensity to cope by venting, engaging in self-blame, denying the problem, and seeking out sources of distraction. Interestingly, there was no evidence of a relationship between grit and coping mechanisms that involved enlisting the help of others, either for the purposes of gaining moral support or assistance in tackling the problem.

Although Lovering et al.’s (2015) study represents a valuable step in elucidating how exactly gritty individuals respond to obstacles, the highly specific nature of the sample warrants further examination of the relationship between grit and coping in different age groups, and across varying contexts. In explaining the link between grit and both success and stress levels, researchers have suggested that coping may represent an important explanatory variable (Meriac et al., 2015; Robertson-Kraft & Duckworth, 2014). Thus, the current study will endeavour to map out, and account for, the relationship between grit and coping in the school context during childhood.

1.1.3.1 Academic Coping

As conceptualized by Skinner, Pitzer, and Steele (2013), there are five coping responses to academic stressors that are adaptive in nature: strategizing, commitment, self-encouragement, comfort-seeking, and help-seeking. Strategizing involves making an effort to understand the causes of an academic difficulty and devise a plan to ensure that it does not reoccur. Through the use of commitment techniques, students work to mentally reinforce the value of the obstacle they
are trying to overcome by relating it to their long-term objectives. In contrast, coping strategies signifying self-encouragement focus on strengthening emotion regulation capacities through enacting reassuring thoughts supporting a positive view of one’s current and future situation. Likewise, comfort-seeking mechanisms also focus on addressing difficult feelings in response to a stressor, but rather than being solitary in nature, they entail gaining encouragement from others. Help-seeking strategies relate in that they also centre on enlisting support from others, but instead of for emotional purposes, they are aimed at acquiring assistance with fixing the problem. Importantly, the coping strategies employed by students in the academic context have implications for both their learning (e.g., Skinner, Pitzer, & Steele, 2016) and psychological functioning (e.g., Shih, 2015).

A variety of evidence exists suggesting that coping strategies are crucial in facilitating academic achievement (MacCann, Fogarty, Zeidner, & Roberts, 2011; Mantzicopoulos, 1990; Skinner, Pitzer, & Steele, 2013; Skinner et al., 2016). In the post-secondary context, there is a significant relationship between grade point average and academic coping, such that college students employing techniques focused on actively working to solve academic problems are more successful in their coursework (MacCann et al., 2011). Furthermore, elementary students who utilize adaptive coping mechanisms to a greater extent earn significantly higher grades (Skinner et al., 2016) and achieve higher scores on standardized tests (Mantzicopoulos, 1990). As to possible variables contributing to this relationship, the evidence consistently suggests that students who respond to academic challenges in a manner supportive of their future success benefit in terms of classroom engagement (Skinner et al., 2013; Skinner et al., 2016). More specifically, the degree to which students report exercising adaptive coping strategies as opposed to maladaptive strategies (i.e., avoidance, attempting to hide difficulties, fixating on feelings of distress and sympathy for one’s self, attributing the problem to others, or allowing stress to hinder reasoning) predicts whether they will continue working to overcome academic struggles or become defeated and quit trying, which in turn relates to their on-task behavioral efforts and emotional enjoyment while at school (Skinner et al., 2013; Skinner et al., 2016). Students who respond to academic stressors with helpful coping strategies devote extra effort to solve their problems, which correlates with greater future affective and behavioral involvement in academic activities (Skinner et al., 2016). Academic engagement is predictive of achievement both when
considered generally, and as a response to encountering obstacles (Skinner et al., 2016), indicating the importance of fostering the usage of productive coping styles.

It is also critical to continue developing our understanding of the predictors of student coping at school given the significant relationship between academic coping and various facets of psychological well-being (e.g., Freire, Ferradás, Valle, Núñez, & Vallejo, 2016; Mantzicopoulos, 1990; Miquelon & Vallerand, 2006; Shih, 2015). Children who typically employ coping strategies from the adaptive realm report having a significantly higher sense of self-worth than individuals relying mainly on negative methods, including blaming others, denying the problem, and criticizing the self (Mantzicopoulos, 1990). Furthermore, greater use of coping strategies acknowledging the presence of academic difficulties and involving strategizing to solve problems predicts a higher degree of positive affect and diminished levels of stress in relation to school (Miquelon & Vallerand, 2006). In addition to academic stress, symptoms of burnout vary as a function of which coping strategies students employ (Shih, 2015). In particular, adolescents who tend to cope by actively problem-solving, strategizing, prioritizing their studies, and asking for support from others are less emotionally defeated by their studies, remain more positive about the importance of their schoolwork, and maintain a greater confidence in their ability to tackle challenges (Shih, 2015). Likewise, in terms of general mental health, self-reported psychological well-being amongst post-secondary students is positively related to their tendency to manage academic stress by enlisting the help of others, positively reframing their view of the situation, and engaging in problem-solving (Freire et al., 2016). Overall, the evidence discussed suggests that gaining insight into potential factors influencing student coping may also add to our understanding of their mental health.

The developmental period involving the transition from middle childhood to adolescence represents a critical stage for the study of coping mechanisms and their implications, particularly in the academic domain. First, the onset of adolescence is accompanied by substantial shifts in the structure of the educational environment, with youth reporting significant declines in the level of support that their teachers provide (Barber & Olsen, 2004) at a time when academic expectations are becoming increasingly demanding (Berk, 2013). Second, adolescents must contend with changes in their academic motivation (Otis, Grouzet, & Pelletier, 2005). More specifically, between the eighth and tenth grades, research findings indicate that students experience a significant reduction in both intrinsic and extrinsic forms of school motivation (Otis
et al., 2005). Third, adolescence constitutes a time of psychological vulnerability, with youth reports indicating significant growth in experienced stress between the ages of 10 and 14 years, a change that is predictive of heightened internalizing symptoms (Felton et al., 2017). Furthermore, it represents a period during which youth may struggle to utilize beneficial coping strategies (Skinner & Zimmer-Gembeck, 2016). Recent findings indicate that the use of coping strategies that permit an individual to make sense of and respond adaptively to academic problems becomes greater from the third grade to the fifth grade (Ben-Eliyahu & Kaplan, 2015). However, the findings also showed that there is a subsequent decline the year after (Ben-Eliyahu & Kaplan, 2015). In culmination, these findings indicate that it is essential to understand the factors predicting usage of adaptive coping practices as adolescence approaches. Thus, this study will focus on the relationship between grit and academic coping in a sample of students from grades 4 to 6.

1.1.3.1.1 Predictors of Academic Coping

The following section will detail variables predicting whether adaptive coping strategies will be employed, and if so, which mechanisms an individual will select.

1.1.3.1.1.1 Self-Determination Theory

According to self-determination theory, healthy psychological functioning is dependent on an individual’s ability to meet needs in three key domains: autonomy, competence, and relatedness (Ryan & Deci, 2000). The level of choice an individual perceives having over their actions, the degree to which they are able to gain a sense of accomplishment from completing tasks, and the extent to which they feel integrated into their social context are each predictive of well-being (Ryan & Deci, 2000). Furthermore, these domains relate to success in the academic context (Niemiec & Ryan, 2009). In addition to predicting enhanced achievement (Niemiec & Ryan, 2009), the fulfillment of these needs correlates with the type of academic coping strategies that students employ (Skinner et al., 2013). Skinner et al. (2013) found that in a sample of students in middle childhood and early adolescence, those who reported greater scholastic competence, autonomy in school tasks, and social relatedness across contexts also made greater use of adaptive academic coping methods, including strategizing, commitment, self-encouragement, comfort-seeking, and help-seeking. Given that grittier individuals endorse significantly greater
feelings of competence and autonomy (Jin & Kim, 2017), a positive self-concept and perceptions of autonomy represent plausible mediators of the relationship between grit and coping.

1.1.3.1.1.2 Self-Efficacy

Inherent in an individual’s sense of competence is the construct of self-efficacy (Skinner & Zimmer-Gembeck, 2016), a variable reflecting the extent to which individuals believe they are capable of successfully managing what is demanded of them (Bandura, 1982). In the school context, research has demonstrated that self-efficacy and self-regulation in relation to learning activities are predictive of student success (Mega, Ronconi, & De Beni, 2014). More specifically, an individual’s perceived self-efficacy for self-regulated learning is a significant correlate of various critical outcomes, such as grades and academic self-concept (Usher & Pajares, 2008a). This domain of self-efficacy refers specifically to confidence in one’s ability to direct actions in a manner supportive of learning, such as maintaining focus on schoolwork despite the presence of distractors or completing assigned work in a timely manner (Usher & Pajares, 2008a).

Importantly, grit represents a dimension of personality significantly predictive of self-efficacy for self-regulated learning (Sturman & Zappala-Piemme, 2017). Across middle childhood and adolescence, students who are more committed to reaching their long-term goals report greater certainty of their capacity to carry out the activities necessary to promote their scholastic success (Sturman & Zappala-Piemme, 2017). Given that children who report greater self-efficacy in relation to school tasks also gravitate towards the use of adaptive coping strategies such as strategizing (Friedel, Cortina, Turner, & Midgley, 2007), the current study will seek to determine whether self-efficacy for self-regulated learning constitutes a mediator of the hypothesized relationship between grit and adaptive academic coping in childhood.

1.1.3.1.1.3 Motivation

Autonomous motivation, particularly in relation to school activities, represents an additional mechanism that may link academic coping with grit. The variety of reasons prompting individuals to carry out the tasks of life can be grouped into three motivational categories: amotivation, extrinsic motivation, and intrinsic motivation (Ryan & Deci, 2000). The crucial feature of these categories is that they differ in the extent to which an individual perceives their actions as being independently self-governed (Ryan & Deci, 2000). In terms of motivation for academic participation, students identifying with a state of amotivation report having no purpose
driving their actions (Gillet, Vallerand, & Lafrenière, 2012), which is the motivational profile reflecting the lowest level of self-determination (Ryan & Deci, 2000). Extrinsic motivation differs in that it reflects incentivized engagement driven by secondary rewards not immediately attained from performing an activity itself (Ryan & Deci, 2000). The subtypes of extrinsic motivation are distinguished by the nature of the reasons promoting action, which determine the level of autonomy afforded by a given profile (Ryan & Deci, 2000). Examples of extrinsic school motivation include introjected motivation, which reflects academic participation based on external expectations, and identified motivation, which characterizes individuals who report having decided to do their schoolwork because it will benefit them (Gillet et al., 2012). In contrast, intrinsic school motivation is defined by engagement in academic tasks purely for the enjoyment derived from them (Gillet et al., 2012). The latter two forms of motivation, identified and intrinsic, can be characterized as autonomous in that actions are viewed as the product of motives inherent to the individual (Gillet et al., 2012; Ryan & Deci, 2000).

There are now multiple studies identifying a positive relationship between grit and self-determination in relation to academic tasks (Datu et al., 2018; Eskreis-Winkler et al., 2014; Ivcevic & Brackett, 2014; Piña-Watson, López, Ojeda, & Rodriguez, 2015). In particular, students who evidence higher levels of grit take greater pleasure in completing school activities (Ivcevic & Brackett, 2014) and report being more motivated to do so (Eskreis-Winkler et al., 2014; Piña-Watson et al., 2015). As to the sources of this academic motivation for grittier students, research findings suggest that they tend to reflect a self-determined rationale (Datu et al., 2018). A recent study conducted by Datu, Yuen, and Chen (2018) found that in a sample of adolescents, higher levels of grit were significantly correlated with greater endorsement of autonomous sources of academic motivation. Given the link between adaptive academic coping strategies and motivational autonomy in relation to school work (Skinner et al., 2013), it seems that the degree of self-determination inherent in a student’s sources of academic motivation represents another plausible mediator linking grit to productive methods of coping with challenges at school.

1.1.3.1.1.4 Appraisals

As was mentioned previously, prior research has found that grit is not predictive of the use of all varieties of adaptive coping, at least in the context of adulthood (Lovering et al., 2015). In a
sample of Marines in training, grit did not relate to the use of coping strategies assisting with emotion regulation or enlisting the help of others (Lovering et al., 2015). Instead, grittier individuals reported a greater reliance on independent future-oriented coping strategies aimed at finding a resolution to encountered problems (Lovering et al., 2015). The current study seeks to determine whether children characterized as higher in grit tend to employ the same pattern of coping styles in response to academic stressors. In accounting for the hypothesized differential prediction of adaptive coping methods by grit, the concept of appraisals seems a relevant explanatory factor.

A seminal study conducted by Folkman, Lazarus, Dunkel-Schetter, DeLongis, and Gruen (1986) demonstrated the crucial importance of mental appraisals in determining how an individual copes with a given situation. Although the mental evaluation of stressful circumstances is multifaceted, the view one takes of their role in addressing the situation is helpful in predicting the coping mechanisms they will select (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). The perception that one has influence over a situation leads to the use of active methods such as strategizing and reframing, whereas the perception that one is not yet fully equipped to manage a situation relates to the use of help-seeking (Folkman et al., 1986). Notably, the finding that a heightened sense of control relates specifically to adaptive coping strategies involving self-reliant problem solving has been replicated in the academic context (Raftery-Helmer & Grolnick, 2016). At the beginning of the adolescent period, greater self-reported control over academic outcomes is significantly related to higher levels of strategizing in response to school-related difficulties, but is not predictive of efforts to gain assistance or reassurance, and is negatively related to the emotion-laden ruminative response (Raftery-Helmer & Grolnick, 2016).

Importantly, there is a variety of evidence suggesting that gritty individuals will tend to feel empowered in addressing challenges (e.g., Lucas et al., 2015), making it likely that in the academic context, grit will predict the efforts of students to tackle obstacles on their own. First, experimental methods have shown a direct positive link between grit and perceived control in stressful circumstances (Lucas et al., 2015). Even under the influence of externally imposed manipulation, higher levels of grit are significantly correlated with greater belief in one’s ability to influence a situation (Lucas et al., 2015). Second, grit is associated with higher levels of both optimism (Sheridan, Boman, Mergler, & Furlong, 2015) and conscientiousness (Duckworth et al., 2007), which are two facets of personality that are predictive of appraising stressors as under
one’s control (Peacock & Wong, 1996; Tong et al., 2006). Third, gritty individuals are less inclined to become emotionally distressed in response to negative outcomes (Lucas et al., 2015), negating the need for strategies focused on instilling a sense of comfort. Lastly, by virtue of their accrued experience focused on the pursuit of goals, grittier individuals have likely had the opportunity to develop a stronger sense of self-agency (van der Weiden, Aarts, & Ruys, 2013), promoting their belief in their ability to shape their own outcomes.

1.2 Implications of Grit and Coping for School-Related Internalizing Symptoms

The final objective of the current study is to determine whether the hypothesized links between grit and adaptive coping translate into reduced anxiety in relation to academic work. More specifically, the goal is to test whether grittier students experience fewer symptoms of math anxiety, and whether this relationship is in turn accounted for, at least in part, by the profile of adaptive coping strategies likely employed by such students.

1.2.1 Math Anxiety

Math anxiety reflects the experience of psychological agitation and feelings of uneasiness in response to the performance of mathematical activities (Jameson, 2013). The construct encompasses negative emotional reactions to carrying out numerical procedures, making mathematical mistakes, and the anticipation of one’s math work being evaluated by others (Jameson, 2013). In terms of causal factors in the development of math anxiety, research evidence implicates both biological and environmental factors as having a role (Wang et al., 2014). In a study of the underpinnings of math anxiety, Wang et al. (2014) determined that amongst a sample of monozygotic and dizygotic twins in early adolescence, around 60 percent of the variance in self-reported math anxiety could be attributed to nonshared aspects of the environment, and approximately 40 percent of the variance was hereditary.

Importantly, the hereditable component of math anxiety has been linked to both non-specific anxiety symptoms encountered in daily life and math application skills (Wang et al., 2014). Likewise, at the neurobiological level, math anxiety relates to functional differences in regions of the brain involved in numerical problem solving and generating emotional responses (Young, Wu, & Menon, 2012). Specifically, Young, Wu, and Menon (2012) found that when children
were asked to solve mathematical problems while undergoing an fMRI scan, those who typically experienced higher math anxiety also had comparatively lower activity levels in regions of the prefrontal cortex, parietal cortex, and basal ganglia, areas where previous research has linked heightened activity with the performance of mathematical procedures (e.g., Menon, Rivera, White, Glover, & Reiss, 2000). Furthermore, while working on the presented tasks, the math-anxious children also exhibited significantly more activity within the right amygdala (Young et al., 2012), a region in which activation is demonstrably heightened in response to emotion-triggering stimuli amongst individuals who tend to be anxious (Stein, Simmons, Feinstein, & Paulus, 2007).

In terms of experiential factors thought to contribute to the development of math anxiety, research evidence has implicated sources of influence both within and outside of the school environment (Ramirez et al., 2018). In particular, the adults involved in supporting children’s learning of math seem to exert a significant influence on whether the subject comes to illicit stress (Ramirez et al., 2018). For example, the reports of individuals who experience math anxiety have implicated stressful student-teacher interactions (Ramirez et al., 2018), and there is also evidence suggesting that the provision of homework assistance by parents who are high in math anxiety can foster its development in children (Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015).

1.2.2 Math Anxiety, Achievement, and Emotional Health

In terms of promoting student well-being in the educational context, math anxiety represents a valuable construct to study. First of all, the presence of math anxiety has negative implications for achievement (e.g., Gunderson, Park, Maloney, Beilock, & Levine, 2018; Wu, Barth, Amin, Malcarne, & Menon, 2012) and vocational decisions (e.g., Ahmed, 2018). There is a significant link between success on mathematical assessments and the level of anxiety induced by the subject, such that individuals who are more math-anxious attain lower scores (Foley et al., 2017; Gunderson et al., 2018; Wu et al., 2012), a relationship that seems to be explained in part by working memory costs (Foley et al., 2017). Furthermore, the likelihood of students pursuing careers in the areas of science, technology, engineering, and mathematics (STEM) varies significantly depending on the development of their math anxiety over time, with adolescents who experience chronically elevated math anxiety being less likely to enter STEM fields than
those with diminishing or minimal levels of math anxiety (Ahmed, 2018). In addition, there is a significant positive relationship between symptoms of math anxiety and the degree of anxiety encountered by individuals in daily life and during the completion of tests (Carey, Devine, Hill, & Szücs, 2017). Given evidence linking the propensity to stress about math to anxiety experienced in relation to other academic domains (Punaro & Reeve, 2012), math anxiety represents a valuable index in assessing the psychological well-being of students at school.

### 1.2.3 Math Anxiety and Grit

In terms of possible targets for interventions aimed at reducing math anxiety, there is agreement amongst researchers that it is important to foster student strength in the face of obstacles (Mammarella, Donolato, Caviola, & Giofrè, 2018; Ramirez et al., 2018). Ramirez et al. (2018) have argued that enacting a positive response to setbacks is crucial to ameliorate math anxiety, and the findings of Mammarella, Donolato, Caviola, and Giofrè (2018) suggest that higher levels of resilience are indeed beneficial. Although at this point in time, there is a lack of research examining how grit relates to math anxiety, there is evidence to suggesting that grittier individuals might be less stressed by math (e.g., Sheridan et al., 2015). In addition to there being a significant negative relationship between grit and general anxiety (Sheridan et al., 2015), grittier students tend to adopt a mastery orientation in relation to their learning (Tucker-Drob, Briley, Engelhardt, Mann, & Harden, 2016), which is negatively correlated with math anxiety (Skaalvik, 2018). Thus, the current work will represent an important development to the literature in elucidating the nature of the relationship between grit and math anxiety.

### 1.2.4 Math Anxiety and Coping

In particular, this study will test whether the hypothesized adaptive academic coping mechanisms affiliated with grit mediate its predicted relationship with math anxiety. During childhood, anxiety symptoms have been found to vary significantly as a function of the coping methods a child typically employs (Thorne, Andrews, & Nordstokke, 2013). Specifically, children who, across circumstances, tend to manage stressors by enlisting the support of others or avoiding the problem, experience more anxiety, whereas children who gravitate towards the use of active coping mechanisms have fewer anxiety symptoms (Thorne et al., 2013). Notably, the evidence also indicates that the use of adaptive versus maladaptive coping strategies in response to math difficulties is significantly predictive of math anxiety (Skaalvik, 2018). Children who
more often respond to mathematical challenges with problem-focused coping mechanisms such as strategizing report significantly lower math anxiety (Skaalvik, 2018). In contrast, children who tend to use maladaptive defensive strategies such as concealment experience higher levels of math anxiety (Skaalvik, 2018). Given the preliminary evidence linking grit to the independent problem-focused family of coping mechanisms (Lovering et al., 2015), they represent a plausible mechanism linking grit to childhood math anxiety.

1.3 Summary and Hypotheses

Recent evidence attesting to the continuing growth in child and youth mental health needs (e.g., Boak et al., 2016) illustrates the critical nature of research examining internal sources of strength connected to student well-being. The objective of the present work is to study the mechanisms through which grit may promote student emotional health in the school context. The topics of inquiry are threefold. First, the current study will seek to determine how gritty students tend to cope with academic challenges. Second, potential mechanisms accounting for the relationship between grit and academic coping will be investigated. Third, the hypothesized relationship between grit and coping for internalizing symptoms in the academic context, as indexed by math anxiety, will be examined. It is hypothesized that grit will positively predict the use of independent proactive coping strategies aimed at taking initiative to address academic problems; namely, strategizing and commitment (Skinner et al., 2013). Furthermore, it is predicted that greater self-efficacy for self-regulated learning and autonomous academic motivation will account for the link between grit and the independent proactive coping profile. Lastly, it is hypothesized that higher levels of grit will predict lower levels of math anxiety, which will be mediated by greater combined use of the strategizing and commitment coping methods.

2 Methods

2.1 Participants

The sample was composed of 56 children (26 females and 30 males) ranging in age from 9 to 12 years ($M = 10.77, SD = 0.85$). All participants were students attending a university laboratory school in an urban city. The school is a unique environment offering educational programming from preschool up until the sixth grade. Distinguishing features of the school include a focus on the provision of empirically-validated teaching practices, the encouragement of learning driven
by inquiry, and the promotion of research in child development and education. In contrast to the public education system, tests are not typically utilized as a mode of assessment.

The children who participated in the current study were enrolled in Grades 4, 5, and 6. Membership across the three grades was fairly evenly distributed, with the sample consisting of 17 students in Grade 4, 20 students in Grade 5, and 19 students in Grade 6. The participants tended to belong to families of high socioeconomic status, as indexed by either maternal or paternal educational attainment. Of the 45 students for whom parents provided demographic information, all belonged to a household where at least one parent had completed post-secondary education. More specifically, with respect to the highest level of education completed by parental informants, 2.2% received a college diploma, 31.1% received an undergraduate university degree, 53.3% received as master’s degree or undergraduate degree in law or medicine, and 13.3% received a doctorate degree. In all cases, parents designated English as a primary language spoken at home; only a small percentage of children (4 of the 45 children whom data was available for, corresponding to 7.1% of the entire sample) were reported to be fluent in another language or exposed to more than one primary language in the home environment. In terms of psychological exceptionalities, 12 children (21.4% of the entire sample) were identified by parents as having a diagnosis of attention-deficit/hyperactivity disorder, a learning disability/dyslexia, autism spectrum disorder, or a mental health disorder; however, information pertaining to all diagnostic categories was only available for 43 children. No inclusion or exclusion criteria were applied during the recruitment or analytic process. All students at the university laboratory school in the relevant grades were invited to participate in the study. Parents provided informed consent enabling their children’s participation, and the children provided assent. Research Ethics Board (REB) approval for the current research was obtained from the University of Toronto and formal consent was provided by the Research Committee at the university laboratory school.

2.2 Measures

The present study was part of a broader research project that included a variety of measures assessing personality variables, emotional functioning, student beliefs, self-concept, coping, academic skills, and classroom and home context. Only the measures that pertain to the current work are reported on in the following sections.
2.2.1 Demographic Information

A questionnaire pertaining to demographic variables was sent home with each participating student for parental completion. This questionnaire requested information regarding parent age, relationship with the student, and educational attainment, in addition to asking about the languages spoken at home, child diagnoses (i.e., attention-deficit/hyperactivity disorder, learning disability/dyslexia, autism spectrum disorder, or mental health disorders), and the educational supports available to the child outside of the classroom.

2.2.2 Grit

The child-adapted version of the Short Grit Scale (Duckworth et al., 2007; Duckworth & Quinn, 2009) was used as a self-report measure of grit. The scale consists of 8 items indexing an individual’s maintenance of their interest in long-term goals and continued devotion of effort to their pursuit. Duckworth and Quinn (2009) provided evidence of its reliability amongst child and adolescent reporters across multiple samples, achieving values of Cronbach’s α ranging from .82 to .84. Participants respond to the questionnaire by indicating on a 5-point Likert scale how well each of the 8 items describes them, selecting one option ranging from (1) Not like me at all to (5) Very much like me. For example, one of the questions requires respondents to reflect on how well the following statement characterizes them: “Setbacks (delays and obstacles) don’t discourage me. I bounce back from disappointments faster than most people.” Half of the items on the questionnaire are phrased in a manner reflective of low levels of grit and are reverse-scored. An individual’s overall grit is calculated as the average of the scores across all items. In the current sample, the scale demonstrated a desirable level of reliability (α = .79).

2.2.3 Academic Coping

The participants also completed the Multidimensional Measure of Coping (Skinner et al., 2013), a 55-item questionnaire designed to assess children’s use of both adaptive and maladaptive coping mechanisms in the academic domain. This measure consists of 11 subscales assessing five adaptive (i.e., strategizing, commitment, self-encouragement, comfort-seeking, and help-seeking) and six maladaptive (i.e., self-pity, concealment, projection, confusion, escape, and rumination) response styles used to manage academic challenges. To complete the questionnaire, students are required to read four different stems representing commonly encountered school-related stressors, including having difficulty with a particular subject or the learning of new
content, struggling during an assessment, or encountering upsetting events relating to general academic performance. Following each stem are a variety of statements representing potential ways of responding to the situations described. Each of the coping subtypes assessed by the questionnaire are represented by five unique items. Minor edits were made to broaden a select few of the items and one stem so as to focus on assessments generally, as opposed to tests specifically, in order to ensure continued validity in the context of the university laboratory school.

The analyses of the present study included only the adaptive subscales, given previous work indicating that grittier individuals tend to cope constructively with difficulty (Lovering et al., 2015). For each item, the participants rated how well the method of response characterized their own actions on a Likert scale with four options, including (1) Not at all true for me, (2) Not very true for me, (3) Sort of true for me, and (4) Very true for me. The items assessing strategizing (e.g., “I try to figure out what I did wrong so that it won’t happen again”), commitment (e.g., “I remind myself that it’s worth it to me in the long run”), self-encouragement (e.g., “I tell myself that it’s not so bad to make a mistake”), comfort-seeking (e.g., “I talk about it with someone who will make me feel better”), and help-seeking (e.g., “I get some help to understand the material better”) have demonstrated satisfactory reliability in previous work, with $\alpha$ values ranging from .59 to .82 (Skinner et al., 2013). In the current sample, the $\alpha$ values for the strategizing, commitment, self-encouragement, comfort-seeking, and help-seeking subscales were .85, .83, .68, .90, and .81, respectively. The mean of the five responses indexing each type of coping was used to create subscale scores.

As outlined in the introduction, it was hypothesized that grit would relate to strategizing and commitment in particular, and thus, a composite of these two coping mechanisms was also created, referred to throughout the remainder of this paper as proactive independent coping. In order to create the composite, participant scores on these two subscales were averaged. In line with the criteria for evaluating scale reliability outlined by Field (2013), all item-total correlations were greater than .3, and the value of Cronbach’s $\alpha$, .87, did not improve if any of the 10 items were removed.
2.2.4 Self-Efficacy for Self-Regulated Learning

Self-efficacy for self-regulated learning was assessed using a 7-item questionnaire adapted from the *Children’s Self-Efficacy Scale* (Bandura, 2006; Usher & Pajares, 2008a). Each item on the questionnaire refers to a distinct task involved in the self-direction of one’s learning, such as completing assignments before deadlines, maintaining attention on academic work, devoting time to study, retaining content in memory, getting involved in classroom activities, and finding the motivation to work. For example, one item asks “How well can you study when there are other interesting things to do?” Respondents are asked to rate how well they believe they are able to perform each task by selecting a number on a scale ranging from 0 (*Not well at all*) to 100 (*Very well*), with response options increasing by 10-unit increments. For the purposes of this study, the wording of some items was adjusted slightly to better reflect the nature of the work assigned to students at the university laboratory school. In previous research, the scale has proven reliable ($\alpha = .83$) (Usher & Pajares, 2008a), which was also true for the current sample ($\alpha = .82$). An overall self-efficacy for self-regulated learning score was generated by averaging participant responses across the seven items.

2.2.5 Autonomous Academic Motivation

The participants also completed the elementary version of the *Academic Motivation Scale* created by Gillet, Vallerand, and Lafrenière (2012) to assess academic motivation in middle childhood and adolescence. The scale provides a measure of four motivational categories in relation to scholastic activities: amotivation, introjected motivation, identified motivation, and intrinsic motivation. Each type of motivation is indexed across three academic tasks; namely, attending school, completing assigned work, and paying attention to the classroom teacher. Following each academic task, four reasons for completing it are listed, representing the different motivational subtypes. For example, the intrinsic and identified motivational profiles, respectively, are indicated by the following statements explaining why one opts to participate at school: “for the pleasure of doing it” and “because I have chosen to do it myself for my own good.” Respondents are asked to rate the extent to which they agree or disagree that each reason motivates their engagement in the designated activities. Response options range from (1) *Strongly Disagree* to (5) *Strongly Agree*. Following the procedure of Gillet et al. (2012), subscale scores for the distinct motivational categories were created by calculating the sum of responses.
across each of the three school-related scenarios. In previous research, all subscales were reliable, attaining $\alpha$ values between .83 and .88 (Gillet et al., 2012). The current work focuses on the intrinsic and identified profiles as indicative of motivational autonomy, and thus a composite score was formed by averaging participants’ scores on the two subscales. In the current sample, Cronbach’s $\alpha$ for the six items reflecting autonomous motivation was .86, all inter-item correlations were above .3, and the $\alpha$ value did not improve upon the deletion of any items.

2.2.6 Math Anxiety

The participants also completed the *Children’s Anxiety in Math Scale* (Jameson, 2013), a 16-item questionnaire assessing the extent to which math related activities are emotionally stressful for students. For each question on the scale, children indicate their emotional response to working on mathematics (e.g., “Thinking about working on math in class makes me feel:”), demonstrating their math skills to others (e.g., “When my teacher says that he or she is going to give me a math problem on the blackboard, I feel:”), and encountering the possibility of making mistakes in mathematics (e.g., “When the teacher gives the class a math problem that I don’t understand, I feel:”). Students respond to each question on a 5-point Likert scale represented pictorially, with response options ranging from (1) a face with a large smile, representing the lowest level of anxiety, to (5) a frowning face that is crying, representing the highest level of anxiety. The measure has been validated for use with elementary school students, demonstrating a desirable level of reliability ($\alpha = .86$) (Jameson, 2013). In the current sample, Cronbach’s $\alpha$ was .94. In accordance with the procedures of the scale developer, math anxiety scores were calculated as the sum of responses across all items.

2.2.7 Procedure

At the start of the study, informed consent packages were sent home with all students eligible to participate, and the students for whom parental consent was obtained then provided their assent before beginning the research tasks. Students were withdrawn briefly from classroom activities on a few occasions to complete the full range of research measures, which required approximately one hour in total. The self-report questionnaires utilized in this study were completed with pencil and paper by the students in a small group setting under the supervision of psychology graduate students. Care was taken to ensure the privacy of student answers was protected as they completed the surveys. Paper copies of the measures to be completed by
parents were also provided to the participating students, which were then returned to the school and subsequently obtained by the researchers. As per the research policies of the university laboratory school, the parents and children were not provided with compensation for their participation; however, the researchers conveyed appreciation for their time and effort.

3 Results

3.1 Plan for Statistical Analyses

The following statistical analyses address this study’s three objectives. The first goal was to determine which adaptive academic coping mechanisms grit correlates with in this sample of upper elementary school children. The second goal was to evaluate whether autonomous academic motivation and self-efficacy for self-regulated learning mediate the hypothesized relationship between grit and the proactive independent coping profile in this age group. The third objective was to test whether the use of proactive independent coping accounts for the predicted relationship between grit and math anxiety. In order to meet these objectives, correlational analyses were run first in order to establish the necessary basis for testing the hypothesized models. The PROCESS macro, version 3.0 (Hayes, 2018), was then employed to assess the proposed mediation pathways. According to the guidelines provided by Field (2013), a sample of greater than 55 participants is recommended to detect a medium effect through regression, and thus, the current sample was large enough to support the statistical procedures described below. All analyses were conducted using IBM SPSS Statistics 24 (IBM Corp., 2016), with an alpha level of .05 used as the criterion for significance. Results are accompanied by 95% percentile confidence intervals generated based on 5000 bootstrap samples, which are reported in square brackets.

3.2 Preliminary Analyses

A variety of descriptive analyses were carried out prior to performing the main analyses. The mean, standard deviation, and range of all variables are reported in Table 1. The Shapiro-Wilk test was included as an assessment of normality, which identified the distributions of the following variables as non-normal ($p < .05$): strategizing, commitment, self-encouragement, comfort-seeking, help-seeking, and autonomous motivation. As a result, non-parametric tests were used to assess the relationships between grit and the individual adaptive coping subscales.
To enable the inclusion of autonomous motivation in parametric analyses, the data were reverse-scored to correct for a negatively skewed distribution before a square root transformation was computed. The transformed data were then reverse-scored again to restore the correct directionality to the tested relationships. The resulting variable was normally distributed.

Descriptive tests also identified a small number of outliers in the study variables. In order to minimize potential bias in the parametric analyses, the outliers were winsorized according to the procedure suggested by Field (2013), such that all outliers were allocated the value of the next extreme case in the dataset that was not unusual. Winsorizing was carried out on one datapoint for grit, autonomous academic motivation, proactive independent coping, and math anxiety.

The Kruskal-Wallis test was also conducted to ensure that there was no significant effect of classroom membership on the variables used in the study. All p-values were greater than .05, confirming that the distribution of each variable did not differ as a function of grade.

3.3 Grit and Coping

3.3.1 Correlations

The relationship between self-reported grit and use of adaptive academic coping methods was evaluated with Spearman’s correlation coefficient. As predicted, there was a significant positive relationship between grit and strategizing, $r_s = .44, [.200, .625], p = .001$, as well as grit and commitment, $r_s = .41, [.158, .609], p = .002$. That is, students who reported being more devoted to their long-term goals reported significantly greater reliance on coping strategies that address academic stressors by mentally reinforcing the value of overcoming them, and formulating a plan for how to do so. In contrast, grit was not significantly correlated with self-encouragement, $r_s = .06, [-.218, .336], p = .659$, comfort-seeking, $r_s = .25, [-.033, .516], p = .059$, or help-seeking, $r_s = .06, [-.205, .331], p = .665$.

As was detailed in the methods section, a composite score summarizing student use of both strategizing and commitment was also created, termed proactive independent coping, which was justified by the significant positive relationship between strategizing and commitment, $r_s = .56, [.317, .741], p < .001$. Given that the composite variable was normally distributed, parametric analyses were used to examine the correlation between grit and proactive independent coping. In
agreement with the study hypotheses, there was a significant positive relationship between the two variables, $r = .54$, $[.318, .707]$, $p < .001$, constituting a large effect size.

### 3.4 Mediators of the Relationship between Grit and Coping

#### 3.4.1 Correlations

Pearson’s correlation coefficient was used to assess the relationships of grit and proactive independent coping with the proposed mediators accounting for their connection: autonomous academic motivation and self-efficacy for self-regulated learning. In agreement with the predictions, there was a significant relationship of large effect size, as indicated by the value of $r$ (Field, 2013), between grit and both autonomous academic motivation, $r = .60$, $[.396, .752]$, $p < .001$, and self-efficacy for self-regulated learning, $r = .57$, $[.349, .724]$, $p < .001$. Thus, grittier students reported a greater sense of motivational self-determination in relation to scholastic endeavours, as well as higher levels of confidence in their ability to direct their behavior in a manner supportive of their studies. Furthermore, self-reported use of the strategies involved in proactive independent coping was significantly and positively correlated with autonomous academic motivation, $r = .62$, $[.383, .787]$, $p < .001$, as well as self-efficacy for self-regulated learning, $r = .62$, $[.408, .763]$, $p < .001$. In other words, the results indicated that students more often address academic challenges by independently adapting their mindset and devising a strategy for addressing the problem when they feel that their participation at school is driven by internal motives, and believe that they can exercise the behavioural self-regulation necessary for learning and achievement. Therefore, the correlation analyses supported the testing of the hypothesized parallel multiple mediator model.

#### 3.4.2 Mediation Analysis

Prior to testing the mediation model, additional analyses were conducted to determine whether the influence of potential covariates needed to be controlled for. Reported in Table 2 are the Spearman correlations between the predictor, mediators, and outcome variable and three possible covariates: age, sex, and psychological exceptionality, defined as the presence of a learning disability/dyslexia, attention-deficit/hyperactivity disorder, autism spectrum disorder, or a mental health disorder. Age was not correlated with any of the variables in the model; however, sex was significantly predictive of grit and autonomous academic motivation, and exceptionality was
correlated with self-efficacy for self-regulated learning. More specifically, female students
tended to report higher levels of grit and motivational autonomy at school, and students with a
psychological exceptionality felt less efficacious in the self-regulation of their learning.

Based on the results of the correlational analyses, a parallel mediator model with grit as the
independent variable, autonomous academic motivation and self-efficacy for self-regulated
learning as the mediators, and proactive independent coping as the dependent variable was
tested, with sex and exceptionality entered as covariates; however, the regression coefficients
indicated that exceptionality was not a significant predictor of the mediators or outcome once
entered into the model (See Table 3), and thus, it was removed. The final model included only
sex as a covariate, and regression coefficients for each path are reported in Table 4. The direct
effect of grit on proactive independent coping after controlling for the other variables in the
model was not significant, $b = 0.12$, $[-0.090, 0.329]$, $p = .257$. In support of the hypothesized
parallel two-mediator model, the indirect effects of grit on proactive independent coping through
self-efficacy for self-regulated learning, $b = 0.15$, $[0.031, 0.299]$, and autonomous academic
motivation, $b = 0.16$, $[0.042, 0.301]$, were both significant, given that the bootstrapped
confidence intervals did not contain zero. The standardized indirect effects through self-efficacy
for self-regulated learning and autonomous academic motivation were $b = .19$, $[.040, .365]$ and $b$
$= .20$, $[.052, .386]$, respectively. Refer to Figure 1 for a diagram depicting the model.

3.5 Grit, Coping, and Math Anxiety

3.5.1 Correlations

In order to address the third objective of the study, correlational analyses were first conducted to
determine how math anxiety related to grit and proactive independent coping. As was
hypothesized, grittier youth reported lower levels of anxiety about math, $r = -.57$, $[-.745, -.339]$
$p < .001$. Furthermore, students who made greater combined use of the strategizing and
commitment coping mechanisms reported that they experienced significantly lower levels of
math anxiety, $r = -.62$, $[-.763, -.438]$, $p < .001$.

3.5.2 Mediation Analysis

A simple mediation model was hypothesized in which proactive independent coping in the
academic context would mediate the relationship between grit and math anxiety. In accordance
with the procedure used to test the previous mediation model, Spearman’s correlation coefficient was used to assess the potential effects of age, sex, and psychological exceptionality as covariates. As shown in Table 2, age and psychological exceptionality were not significantly related to grit, proactive independent coping, or math anxiety; however, sex was significantly related to math anxiety, and as previously mentioned, grit. In particular, male students tended to report greater levels of math anxiety in the current sample. Thus, the model was first tested with sex entered as a covariate (See Table 5); however, once the other variables in the model were included, sex did not remain a significant predictor of math anxiety, and therefore, it was subsequently removed from the model. The final model included grit as the predictor, proactive independent coping as the mediator, and math anxiety as the outcome. Regression coefficients for each path in the model are included in Table 6. The direct effect of grit on math anxiety, controlling for proactive independent coping, remained significant, $b = -5.59$, [-9.702, -1.473], $p = .009$. As was predicted, there was also a significant indirect effect of grit on math anxiety through proactive independent coping, $b = -4.12$, [-7.317, -1.321], with a standardized value of $b = -.24$, [-.401, -.081]. Refer to Figure 2 for a diagram depicting the model.

4 Discussion

This study was conducted with the intent of answering three main questions concerning the relationship between grit and coping during mid to late childhood. The first objective was to determine how students who have higher grit scores cope in response to encountering academic stressors. As a follow-up, the second objective was to investigate specific mechanisms (e.g., greater self-efficacy for self-regulated learning and autonomous academic motivation) that may account for the link between grit and specific coping styles. Last, the third objective was to explore the implications of more proactive coping approaches reported to be used by gritty students to support their self-reported emotional health in the school context. The current work represents an important development to the literature in that it combines the bodies of work examining grit in relation to academic achievement (e.g., Duckworth et al., 2007; Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014) and psychological well-being (e.g., Blalock et al., 2015; Datu et al., 2018; Jin & Kim, 2017; Lucas et al., 2015; Meriac et al., 2015; Salles et al., 2014; Vainio & Daukantaitė, 2016) by asking how grittiness may shape cognitive and behavioral reactions to the challenges inherent in the learning process.
4.1 Grit as a Predictor of Coping

With regards to the first research question, it was hypothesized that elementary students who possess higher levels of grit would react to academic setbacks by employing proactive independent coping strategies; namely, strategizing and commitment. This prediction was supported in the current sample, as evidenced by significant positive correlations between grit and both strategizing and commitment, as well as a composite variable reflecting their combined use. In addition, grit was not significantly predictive of any of the remaining adaptive academic coping strategies: self-encouragement, comfort-seeking, and help-seeking.

Importantly, the findings of the present work align with those of Lovering et al. (2015), who evaluated the relationship between grit and coping amongst a sample of men preparing to become Marines. In terms of adaptive strategies, Lovering et al. found that grittier individuals reported adopting a positive perspective on their sources of difficulty, as well as employing a problem-focused approach involving planning, mechanisms that are analogous in nature to commitment and strategizing. Furthermore, Lovering et al.’s work did not detect a significant relationship between grit and efforts to acquire help or reassurance from others, which is consistent with the present results. To the author’s knowledge, there is no previous work examining the link between grit and a coping strategy comparable to self-encouragement; however, our finding that grit did not relate to the use of self-talk aimed at emotion regulation aligns with previous work illustrating that grit predicts emotional resilience in the face of stress (e.g., Lucas et al., 2015), rendering the rehearsal of soothing thoughts in times of difficulty unnecessary.

Thus, the results of the present work align with the limited existing literature (i.e., Lovering et al., 2015) in demonstrating that grit is predictive of self-reliant initiative-taking in the domain of coping. By examining the relationship between grit and coping in a different situational context and developmental stage than previous work, the current study represents an addition to the evidentiary base that supports the generalizability of this pattern.

4.2 Mediators linking Grit and Coping

In relation to the second study objective, it was predicted that the positive relationship between grit and proactive independent coping would be mediated by two variables: self-efficacy for self-
regulated learning and autonomous academic motivation. This hypothesis was supported as well. When tested as a parallel multiple mediator model, the indirect effects through each mediator were significant. These results suggest that greater confidence in one’s capacity to engage in self-regulated study behaviors, and an enhanced sense of self-determination in the motives underlying one’s scholastic activities, account, at least in part, for the link between grittiness and the tendency to address academic stressors by re-committing to one’s learning goals and devising a strategy to promote success going forward.

Although this is the first study to examine mediators of the relationship between grit and coping, the results are consistent with previous work examining the pathways inherent in this model. In general, individuals who are grittier report feeling significantly more competent and autonomous than those who report low levels of grit (Jin & Kim, 2017), and there is evidence extending these relationships to the academic realm (e.g., Datu et al., 2018; Sturman & Zappala-Piemme, 2017). In line with the current research, previous work also has found that youth who are more inclined to persist through challenges in order to reach their long-term goals have greater self-efficacy for self-regulated learning (Sturman & Zappala-Piemme, 2017) and endorse higher levels of self-determination in relation to their academic motivation (Datu et al., 2018). Furthermore, researchers have also reported that elementary students are more likely to employ the full range of adaptive coping strategies to solve school-related problems when they feel more efficacious academically and view their participation at school as reflective of greater motivational autonomy (Skinner et al., 2013). In terms of practical implications, these findings offer important suggestions as to how adaptive academic coping can be fostered. For example, self-efficacy for self-regulated learning is theoretically and empirically related to sources of self-efficacy such as mastery experience and social persuasion (Usher & Pajares, 2008b). Thus, in addition to directly scaffolding the use of helpful coping strategies, parent and teachers might further promote their use by offering children opportunities to succeed in their schoolwork, and providing positive feedback about their academic skills.

Therefore, the results of the present work serve multiple purposes. First, they serve as a replication of previous findings that reaffirms the predictive utility of grit in forecasting student perceptions of personal academic competence and autonomy (e.g., Datu et al., 2018; Sturman & Zappala-Piemme, 2017). Second, they offer further validation of the positive relationship between the latter two variables and adaptive academic coping (e.g., Skinner et al., 2013). Third,
they advance the literature by providing the first evaluation of potential mediators connecting grit to its distinctive coping profile, suggesting that the sense of self-determination and competence characteristic of gritty individuals (Jin & Kim, 2017) likely play a critical role in shaping the way such individuals respond to challenges.

4.3 Coping as a Mediator of the Relationship between Grit and Math Anxiety

The third goal of this study was to explore how the coping profile employed by gritty individuals relates to their psychological health at school, as opposed to their academic achievement. In order to index school-related internalizing symptoms, math anxiety was selected as the outcome variable. It was hypothesized that higher levels of grit would correlate with significantly lower math anxiety, and that this relationship would be accounted for by greater use of proactive independent coping.

In support of the first hypothesis, there was a significant negative correlation between grit and math anxiety, such that students who exhibited greater devotion to the pursuit of long-term goals reported feeling less psychological apprehension in relation to mathematical work. At this point in time, there is no published literature evaluating the relationship between math anxiety and grit, and thus, these findings represent the first evidence suggesting the potential emotional benefits of grittiness for students in mathematics class. Despite the lack of research in this area, the findings of this study are consistent with previous work indicating that grit is typically associated with lower levels of anxiety (e.g., Sheridan et al., 2015; Sturman & Zappala-Piemme, 2017). This relationship has been detected in samples that include children and adolescents (Sturman & Zappala-Piemme, 2017), as well as young adults (Sheridan et al., 2015), and applies to both generic (Sheridan et al., 2015) and test anxiety (Sturman & Zappala-Piemme, 2017). Thus, the present results agree with existing work (e.g., Sturman & Zappala-Piemme, 2017) in suggesting that elementary students who are higher in grit will be less likely to experience academic anxiety. However, given the cross-sectional nature of the data, we can only hypothesize the direction of the effect.

The presence of a significant negative relationship between grit and math anxiety allowed for the preliminary evaluation of the study’s final research question; namely, does the proactive coping profile characteristic of grittier students account for their lower math anxiety? Aligning with the
initial predictions, there was a significant indirect effect of grit on math anxiety through proactive independent coping. More specifically, higher levels of grit predicted greater usage of the strategizing and commitment coping strategies, which in turn, was related to lower levels of math anxiety, and partly accounted for the negative relationship between grit and math anxiety. Notably, the latter relationship was still significant even after controlling for proactive independent coping, suggesting the existence of other potential mediating variables connecting grit to math anxiety. Although these results tested a novel mediation model, its statistical significance in the context of this study corresponds with other research finding that students tend to be less anxious about math when they employ action-oriented coping strategies that focus on addressing challenges (Skaalvik, 2018), the response style typical of individuals high in grit (Lovering et al., 2015).

In summary, the present research offers a further contribution to the literature in providing initial evidence suggesting that youth who are inclined to strive for the attainment of long-term goals experience less emotional stress in response to mathematics, a relationship that is accounted for in part by their tendency to tackle problems in a proactive independent manner. Future research can build upon these findings by exploring the role of additional mechanisms that may explain the lower anxiety levels affiliated with grit and use longitudinal research designs to better understand the relations among these constructs over time. For example, learning goal orientation represents a potential mediator that may be valuable to investigate, given that higher levels of grit (Tucker-Drob et al., 2016) and lower math anxiety (Skaalvik, 2018) both correlate with greater endorsement of the mastery orientation, or desire to engage academically to achieve intellectual growth (Tucker-Drob et al., 2016).

4.4 Limitations

Although the results of this study constitute an important advance in our knowledge of the relationship between grit and coping amongst upper elementary students, and the implications of this relationship for student psychological well-being at school, there are limitations inherent in this research that need to be acknowledged. There are several factors that can be built upon in future work in order to ensure the generalizability of these findings, and further their utility in guiding educational, clinical, and parenting practices: the nature of the sample, study design, and specificity of the outcome variables.
The size and homogeneous nature of the current sample represent one factor limiting the external validity of these findings, pending further replication. As was described in the methods section, the sample was drawn from a private elementary school housed within a university environment, and parents of the participating students were often highly educated. Importantly, there is evidence indicating that the experience of socio-economic stress during childhood is detrimental to one’s ability to cope (Evans & Kim, 2013). Thus, it will be critical for future work to examine the relationships analyzed here across diverse contexts, particularly amongst more vulnerable populations, in order to provide a more stringent assessment of the potential protective role of grit as a promoter of adaptive coping and emotional well-being in the classroom.

Furthermore, the correlational cross-sectional design of the current work prohibits any conclusions regarding the directionality or causality of the detected relationships. To justify the future testing of potential interventions designed to foster grit amongst children and adolescents, it will first be necessary to conduct longitudinal research evaluating whether naturalistic changes in student grit across time are predictive of positive developments in coping and emotional functioning. A criticism of the existing literature surrounding grit and well-being is that there is a lack of research examining the implications of changes in grit for psychological functioning. Many studies examine the relationship between grit and indices of mental health at a single time point (e.g., Datu et al. 2018; Jin & Kim, 2017), or utilize a measure of grit collected at the beginning of a study to predict subsequent well-being after a period of weeks or months (e.g., Blalock et al., 2015; Salles et al., 2014). Importantly, there is evidence to suggest that grit may increase as people become older (Duckworth et al., 2007), which although cross-sectional, aligns with longitudinal research charting the development of other personality variables with age, such as the closely related construct of conscientiousness (Roberts, Walton, & Viechtbauer, 2006). Thus, in order to better evaluate grit as a candidate trait to promote in prevention efforts aimed at fostering the psychological resilience and academic success of students, longitudinal studies and intervention work tracking the consequences of change in grit will be critical.

The third limitation of the current work concerns the select focus of the outcome variables; namely, adaptive academic coping and math anxiety. Although the use of these constructs provides valuable insight into how grittiness may reduce academic-related emotional stress and promote better learning outcomes, it will be important for future studies to examine how grit
relates to coping with other stressors present in the school environment, and how this in turn shapes broader indices of psychological well-being during childhood and adolescence.

### 4.5 Implications

The results of this study constitute preliminary evidence demonstrating that in the later years of elementary school, youth who report higher levels of grit tend to address academic challenges by themselves, focusing on the importance of solving the problem and independently devising a strategy for how to do so. With respect to the anxiety induced by mathematics, this proactive independent coping profile appears beneficial, at least within the context of the current sample. Recognizing that these results support the conceptualization of grit as a personal resource facilitative of an adaptive response to scholastic challenges that is predictive of reduced levels of academic stress, there remain additional avenues for empirical investigation that should be explored in order to best inform practice.

One question in need of further research concerns whether there are any disadvantages to the coping profile characteristic of grittier individuals. In particular, if grit is not significantly related to help-seeking, are there contexts in which the grittier individual is more susceptible to psychological stress? Notably, there is an ample amount of research demonstrating that help-seeking is an individual coping strategy critical to both academic success (e.g., Duchesne, Larose, & Feng, 2017; Schenke, Lam, Conley, & Karabenick, 2015; Shields, 2001), and emotional well-being (e.g., Asselmann, Wittchen, Lieb, Höfler, & Beesdo-Baum, 2014; Shim, Rubenstein, & Drapeau, 2016; Skaalvik, Federici, Wigfield, & Tangen, 2017).

In particular, students who are more inclined to cope with challenges by seeking help evidence benefits in terms of their learning behavior (Duchesne et al., 2017), achievement (Schenke et al., 2015), and educational attainment (Shields, 2001). For example, Duchesne, Larose, and Feng (2017) found a significant longitudinal relationship between student efforts to acquire their teacher’s assistance and levels of student behavioural engagement the following year amongst adolescents in Grades 7 through 9. Furthermore, help-seeking is predictive of higher mathematics test scores at the conclusion of the academic year, even after accounting for skill level assessed at the beginning of the year (Schenke et al., 2015). Beyond academic participation and performance, students who are willing to ask for help are also more likely to complete their
first year of post-secondary education (Shields, 2001). Thus, the help-seeking coping strategy represents a valuable resource promoting scholastic success.

With regards to well-being, there is also evidence demonstrating that help-seeking is predictive of enhanced emotional functioning in the classroom (e.g., Shim et al., 2016; Skaalvik et al., 2017), in addition to reduced risk for the development of mental health problems (e.g., Asselmann et al., 2014). More specifically, middle school students who are more likely to ask their peers for help in order to resolve a learning difficulty report experiencing a higher degree of positive emotions in relation to academic activities (Shim et al., 2016). Likewise, adolescents who seek instrumental support to address mathematical difficulties report that the subject is significantly less anxiety-provoking (Skaalvik et al., 2017). Even amongst individuals already experiencing symptoms of anxiety, help-seeking appears to play a protective role, reducing the likelihood of the subsequent development of internalizing disorders (Asselmann et al., 2014).

It is important to mention that there is empirical evidence suggesting that grittiness can be a risk factor for those in a vulnerable mental state (Anestis & Selby, 2015). Anestis and Selby (2015) examined the link between non-suicidal self-injury and suicidal behaviour in a sample of undergraduate students, and found that grit was a significant moderator of the relationship. Notably, engagement in non-suicidal self-injury was significantly more predictive of an individual having made more attempts to commit suicide as grit increased, indicating that once having reached the point of engaging in self-harm, grittier individuals are more likely to try to take their own life. Given the evidence that youth who commit self-harm have difficulty seeking help despite acknowledging their need for it (Evans, Hawton, & Rodham, 2005), the inclination of gritty individuals to handle their challenges alone (e.g., Lovering et al., 2015) is particularly concerning.

Therefore, the results of the current study speak to the potential positive consequences of grit for academic coping and subject-specific anxiety in the ideal context of a supportive school, implementing the best educational practices, situated within a community of high socioeconomic status. What remains to be determined in future work is whether these relationships persist across diverse circumstances, and whether the nature of their implications remains the same. Student motivational autonomy at school and feelings of academic competence are not only related to the strategies designated here as proactive and independent, but they also predict greater help-
seeking, comfort-seeking, and self-encouragement (Skinner et al., 2013). Therefore, it will be critical for subsequent research to evaluate other potential factors, such as appraisals (Folkman et al., 1986), that may account for the highly specific coping profile of individuals high in grit. This knowledge will be invaluable in helping to determine what should be fostered in combination with grit to ensure that those who passionately strive for their goals also pursue help when they need it.

Although there is a scarcity of studies evaluating efforts to enhance grit (Credé, Tynan, & Harms, 2017), genetic research suggests that its development is amenable to environmental influence, and hence intervention (Rimfeld, Kovas, Dale, & Plomin, 2016). Prior to testing the consequences of systematic initiatives to foster grit, it will be important to conduct further research mapping the mechanisms through which nurturing grit promotes success and well-being, as well as potential factors moderating these relationships, in order to ensure that grit serves only as a positive source of strength. For example, self-regulation constitutes a variable worth investigating, given its positive relationship with grit and academic outcomes (Muenks, Wigfield, Yang, & O’Neal, 2017). Researchers have suggested that when combined with higher levels of self-control enabling the daily regulation of behaviour in support of small goals, the empowering nature of grit may be even stronger (Duckworth & Gross, 2014).

4.6 Conclusion

This study represents an important step in understanding the pathways through which grit may promote success and well-being at school during childhood and early adolescence. Although preliminary, it represents the first examination of the academic coping methods affiliated with grit at this developmental stage, as well as the mediators accounting for that coping profile, and its implications for school-related internalizing symptoms. Consistent with previous research (i.e., Lovering et al., 2015), the present results indicate that grit is predictive of the use of adaptive coping strategies that seek to tackle challenges without the assistance of others. Greater levels of autonomous academic motivation and self-efficacy for self-regulated learning demonstrated significant explanatory power as mediators linking grit with the proactive independent coping profile. Importantly, this style of coping was found to in turn partially account for the lower level of math anxiety correlated with grit.
These findings have two main implications. First, during the elementary years, grit appears to constitute a helpful personal resource at school that is likely supportive of resilience, for it relates to a unique response pattern in the context of challenges that is predictive of reduced emotional stress. Second, the tendency of grittier youth to cope independently may warrant the guidance of educators and parents encouraging such individuals to seek help when necessary. Future research aimed at clarifying the conditions under which grit can best promote successful learning and psychological well-being will serve as an important advance to the literature.
References


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Sweeting, H., West, P., Young, R., and Der, G. (2010). Can we explain increases in young people’s psychological distress over time? *Social Science and Medicine, 71*(10), 1819-1830. doi:10.1016/j.socscimed.2010.08.012


### Tables

Table 1 *Mean, standard deviation, and range of study variables.*

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>10.77</td>
<td>0.85</td>
<td>9.33</td>
<td>12.08</td>
</tr>
<tr>
<td>Grit</td>
<td>3.48</td>
<td>0.66</td>
<td>1.75</td>
<td>4.88</td>
</tr>
<tr>
<td>Strategizing</td>
<td>3.20</td>
<td>0.65</td>
<td>1.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Commitment</td>
<td>3.05</td>
<td>0.58</td>
<td>1.60</td>
<td>4.00</td>
</tr>
<tr>
<td>Self-Encouragement</td>
<td>2.87</td>
<td>0.55</td>
<td>1.60</td>
<td>3.80</td>
</tr>
<tr>
<td>Comfort-Seeking</td>
<td>2.86</td>
<td>0.80</td>
<td>1.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Help-Seeking</td>
<td>3.33</td>
<td>0.55</td>
<td>2.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Proactive Independent Coping</td>
<td>3.13</td>
<td>0.54</td>
<td>1.50</td>
<td>4.00</td>
</tr>
<tr>
<td>Self-Efficacy for Self-Regulated Learning</td>
<td>68.44</td>
<td>17.03</td>
<td>28.57</td>
<td>100.00</td>
</tr>
<tr>
<td>Autonomous Academic Motivation</td>
<td>11.30</td>
<td>2.58</td>
<td>3.50</td>
<td>15.00</td>
</tr>
<tr>
<td>Math Anxiety</td>
<td>40.41</td>
<td>11.30</td>
<td>18.00</td>
<td>69.00</td>
</tr>
</tbody>
</table>

*Note.* Grit (*Short Grit Scale*), the adaptive academic coping subtypes and proactive independent coping composite (*Multidimensional Measure of Coping*), self-efficacy for self-regulated learning (adapted from the *Children’s Self-Efficacy Scale*), autonomous academic motivation (*Academic Motivation Scale, Elementary Version*), and math anxiety (*Children’s Anxiety in Math Scale*) each represent raw scores on their respective measures.
Table 2: Spearman’s correlation coefficients relating grit, self-efficacy for self-regulated learning, autonomous academic motivation, proactive independent coping, and math anxiety with age, sex, and psychological exceptionality

<table>
<thead>
<tr>
<th></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. Grit</td>
<td>1</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>43</td>
</tr>
<tr>
<td>2. Self-Efficacy for Self-Regulated Learning</td>
<td>.49***</td>
<td>1</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>43</td>
</tr>
<tr>
<td>3. Autonomous Academic Motivation</td>
<td>.59***</td>
<td>.51***</td>
<td>1</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>43</td>
</tr>
<tr>
<td>4. Proactive Independent Coping</td>
<td>.50***</td>
<td>.59***</td>
<td>.58***</td>
<td>1</td>
<td>.56</td>
<td>.56</td>
<td>.56</td>
<td>43</td>
</tr>
<tr>
<td>5. Math Anxiety</td>
<td>-.53***</td>
<td>-.60***</td>
<td>-.69***</td>
<td>-.61***</td>
<td>1</td>
<td>.56</td>
<td>.56</td>
<td>43</td>
</tr>
<tr>
<td>6. Age</td>
<td>-.23</td>
<td>.07</td>
<td>-.18</td>
<td>.02</td>
<td>.17</td>
<td>1</td>
<td>56</td>
<td>43</td>
</tr>
<tr>
<td>7. Sex</td>
<td>.38**</td>
<td>.22</td>
<td>.54***</td>
<td>.19</td>
<td>-.28*</td>
<td>.00</td>
<td>1</td>
<td>43</td>
</tr>
<tr>
<td>8. Psychological Exceptionality</td>
<td>-.28</td>
<td>-.31*</td>
<td>-.25</td>
<td>-.25</td>
<td>.18</td>
<td>-.10</td>
<td>-.22</td>
<td>1</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$, *** $p < .001$. Sample sizes are reported above the diagonal. Males received a code of 0 and females received a code of 1. Variables 1. through 4., respectively, were derived from the following measures: the Short Grit Scale, Children’s Self-Efficacy Scale (Adapted), elementary version of the Academic Motivation Scale, Multidimensional Measure of Coping, and Children’s Anxiety in Math Scale.
Table 3 *Regression coefficients for mediation model including psychological exceptionality and sex as covariates, grit as the predictor, self-efficacy for self-regulated learning and autonomous academic motivation as parallel mediators, and proactive independent coping as the outcome. 95% percentile confidence intervals based on 5000 bootstrap samples are reported in square brackets.*

<table>
<thead>
<tr>
<th>Outcome: Self-Efficacy for Self-Regulated Learning</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>23.74 [-1.247, 48.731]</td>
<td>.062</td>
</tr>
<tr>
<td>Grit</td>
<td>12.85 [ 5.480, 20.221]</td>
<td>.001</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.54 [-10.194, 9.111]</td>
<td>.910</td>
</tr>
<tr>
<td>Psychological Exceptionality</td>
<td>-5.59 [-15.715, 4.525]</td>
<td>.270</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome: Autonomous Academic Motivation</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.64 [-0.121, 1.406]</td>
<td>.097</td>
</tr>
<tr>
<td>Grit</td>
<td>0.47 [0.240, 0.690]</td>
<td>.0002</td>
</tr>
<tr>
<td>Sex</td>
<td>0.40 [0.101, 0.691]</td>
<td>0.10</td>
</tr>
<tr>
<td>Psychological Exceptionality</td>
<td>0.03 [-0.280, 0.338]</td>
<td>.850</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Outcome: Proactive Independent Coping</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.17 [0.458, 1.892]</td>
<td>.002</td>
</tr>
<tr>
<td>Grit</td>
<td>0.10 [-0.157, 0.349]</td>
<td>.447</td>
</tr>
<tr>
<td>Self-Efficacy for Self-Regulated Learning</td>
<td>0.01 [0.005, 0.023]</td>
<td>.004</td>
</tr>
<tr>
<td>Autonomous Academic Motivation</td>
<td>0.27 [-0.020, 0.563]</td>
<td>.067</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.01 [-0.290, 0.278]</td>
<td>.966</td>
</tr>
<tr>
<td>Psychological Exceptionality</td>
<td>0.01 [-0.271, 0.283]</td>
<td>.965</td>
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<table>
<thead>
<tr>
<th>Outcome: Proactive Independent Coping</th>
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<th></th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>1.67 [0.889, 2.456]</td>
<td>.0001</td>
</tr>
<tr>
<td>Grit</td>
<td>0.40 [0.166, 0.629]</td>
<td>.001</td>
</tr>
<tr>
<td>Sex</td>
<td>0.09 [-0.209, 0.397]</td>
<td>.533</td>
</tr>
<tr>
<td>Psychological Exceptionality</td>
<td>-0.06 [-0.380, 0.255]</td>
<td>.693</td>
</tr>
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| Direct Effect                                     | 0.10 [-0.157, 0.349] | .447 |

<table>
<thead>
<tr>
<th>Indirect Effect</th>
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<tr>
<td>Self-Efficacy for Self-Regulated Learning</td>
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<td></td>
</tr>
<tr>
<td>Autonomous Academic Motivation</td>
<td>0.13 [-0.017, 0.287]</td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 43.*
Table 4 *Regression coefficients for mediation model including sex as a covariate, grit as the predictor, self-efficacy for self-regulated learning and autonomous academic motivation as parallel mediators, and proactive independent coping as the outcome. 95% percentile confidence intervals based on 5000 bootstrap samples are reported in square brackets.*

<table>
<thead>
<tr>
<th>Outcome: Self-Efficacy for Self-Regulated Learning</th>
<th>b</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>16.89 [-4.860, 38.634]</td>
<td>.125</td>
</tr>
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<td>Sex</td>
<td>0.46 [-7.895, 8.805]</td>
<td>.913</td>
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<table>
<thead>
<tr>
<th>Outcome: Autonomous Academic Motivation</th>
<th>b</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.76 [0.068, 1.449]</td>
<td>.032</td>
</tr>
<tr>
<td>Grit</td>
<td>0.43 [0.229, 0.641]</td>
<td>.001</td>
</tr>
<tr>
<td>Sex</td>
<td>0.41 [0.145, 0.675]</td>
<td>.003</td>
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<table>
<thead>
<tr>
<th>Outcome: Proactive Independent Coping</th>
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<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.21 [0.614, 1.800]</td>
<td>.0002</td>
</tr>
<tr>
<td>Grit</td>
<td>0.12 [-0.090, 0.329]</td>
<td>.257</td>
</tr>
<tr>
<td>Self-Efficacy for Self-Regulated Learning</td>
<td>0.01 [0.003, 0.018]</td>
<td>.009</td>
</tr>
<tr>
<td>Autonomous Academic Motivation</td>
<td>0.36 [0.123, 0.598]</td>
<td>.004</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.15 [-0.389, 0.085]</td>
<td>.204</td>
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<table>
<thead>
<tr>
<th>Outcome: Proactive Independent Coping</th>
<th>b</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.65 [0.980, 2.324]</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Grit</td>
<td>0.43 [0.225, 0.626]</td>
<td>.0001</td>
</tr>
<tr>
<td>Sex</td>
<td>0.00 [-0.258, 0.258]</td>
<td>.9985</td>
</tr>
</tbody>
</table>

*Note. N = 56.*
Table 5 *Regression coefficients for mediation model including grit as the predictor, proactive independent coping as the mediator, math anxiety as the outcome, and sex as a covariate. 95% percentile confidence intervals based on 5000 bootstrap samples are reported in square brackets.*  

<table>
<thead>
<tr>
<th>Outcome: Proactive Independent Coping</th>
<th>$b$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.65</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Grit</td>
<td>0.43</td>
<td>.0001</td>
</tr>
<tr>
<td>Sex</td>
<td>0.00</td>
<td>.999</td>
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<table>
<thead>
<tr>
<th>Outcome: Math Anxiety</th>
<th>$b$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>89.59</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Grit</td>
<td>-5.30</td>
<td>.019</td>
</tr>
<tr>
<td>Proactive Independent Coping</td>
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<td>.0005</td>
</tr>
<tr>
<td>Sex</td>
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<td>.701</td>
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</table>

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<th>$p$</th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
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<tr>
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<tr>
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<thead>
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<th>Direct Effect</th>
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<th>$p$</th>
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<tr>
<td>-5.30</td>
<td>.019</td>
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<table>
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<tr>
<th>Indirect Effect</th>
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<tr>
<td>Proactive Independent Coping</td>
<td>-4.12</td>
<td>[-7.585, -1.294]</td>
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</table>

*Note. N = 56.*
<table>
<thead>
<tr>
<th>Outcome: Proactive Independent Coping</th>
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<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.65</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Grit</td>
<td>0.43</td>
<td>&lt; .0001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome: Math Anxiety</th>
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<th>p</th>
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</thead>
<tbody>
<tr>
<td>Constant</td>
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<tr>
<td>Grit</td>
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<td>.009</td>
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<tr>
<td>Proactive Independent Coping</td>
<td>-9.67</td>
<td>.0005</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome: Math Anxiety</th>
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<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
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</tr>
<tr>
<td>Grit</td>
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<td>&lt; .0001</td>
</tr>
</tbody>
</table>

*Note. N = 56.*
Figure 1. Diagrammatic illustration of mediation model including grit as the predictor, self-efficacy for self-regulated learning and autonomous academic motivation as parallel mediators, proactive independent coping as the outcome, and sex as a covariate. 95% percentile confidence intervals based on 5000 bootstrap samples are reported in square brackets.
Figure 2. Diagrammatic illustration of mediation model including grit as the predictor, proactive independent coping as the mediator, and math anxiety as the outcome. 95% percentile confidence intervals based on 5000 bootstrap samples are reported in square brackets.