British Journal of Educational Psychology (2020)

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When anxiety becomes my propeller: Mental toughness moderates the relation between academic anxiety and academic avoidance

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Background. High academic anxiety is associated with poor academic performance. One proposed mechanism of this association is that academic anxiety promotes learning avoidance behaviours, which in turn hinders students' opportunities to learn and grow. However, this proposition has not been thoroughly examined, particularly in afterschool learning settings. The present study aimed to address this gap.

Aims. First, we investigated whether individual differences in academic anxiety across three domains (mathematics, native language or L1, and second language learning or L2) predicted students' academic avoidance in the corresponding domain in high school. Second, given that individual differences in personality may result in employing different coping strategies to deal with academic anxiety, we examined how mental toughness (MT) moderated the relation between academic anxiety and academic avoidance.

Sample. Two waves of longitudinal data that were one semester apart were available for four hundred and forty-four high school students.

Methods. Students self-reported their MT, academic anxiety, and academic avoidance (i.e., time spent on studying a subject afterschool) in mathematics, L1, and L2.

Results. For students with higher MT, higher mathematics, L1, and L2 anxiety in the first semester predicted more time spent on learning the corresponding subject in the following semester, even after controlling for general anxiety, academic achievement, and initial academic avoidance.

Conclusions. These results challenge the proposition that all students with higher domain-specific anxiety are more likely to avoid learning altogether in that domain. Rather, among students from the general school population who generally exhibit low to moderate levels of academic anxiety, higher academic anxiety is associated with more time investment in afterschool learning in mentally tough students.

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DOI:10.1111/bjep.12366

High anxiety for a specific academic domain, such as mathematics anxiety (MA), is associated with low achievement in the corresponding subject (i.e., mathematics). Moreover, studies have shown that individuals who experience high academic anxiety tend to avoid activities in that field, from avoiding taking elective classes to not pursuing careers in that discipline (Hembree, 1990; LeFevre, Kulak, & Heymans, 1992; MacIntyre & Charos, 1996). However, studies have not fully investigated whether the avoidance behaviours associated with domain-specific anxiety are also observed earlier down the academic pathway, when considering afterschool learning activities in compulsory educational settings. For example, when students with high levels of MA take a required mathematics class, where complete avoidance is not an option, do they spend less time on learning the class materials compared to students with low MA? A related, and largely unexamined question concerns how differences in students' general coping strategies may influence their ways of dealing with anxiety in learning. A personality trait that has been linked to individual differences in the ability to cope with challenges is mental toughness (MT), which describes individuals' abilities to overcome obstacles through persevering, embracing challenges, taking responsibility, and maintaining confidence (Clough, Earle, & Sewell, 2002). Research has shown that mentally tough individuals are more likely to cope with challenges by employing active and approaching coping strategies rather than avoidance. As such, when dealing with their academic anxiety, will mentally tough students engage in learning behaviours that are different from those embraced by students with low MT? The present study addresses two main outstanding research questions concerning the unfolding of academic anxiety in three academic domains – mathematics, native language learning (L1), and second language learning (L2): (1) Is the association between domain-specific anxiety and learning avoidance observed for afterschool learning activities in compulsory educational settings? (2) Does the association between domain-specific anxiety and learning avoidance differ as a function of students' levels of MT?

Academic anxiety and learning avoidance

Academic anxiety refers to the feelings of apprehension and worry towards activities related to a specific school subject or academic domain. To date, research on domain-specific academic anxiety has been mostly concerned with investigating anxiety in the domain of mathematics. Mathematics anxiety describes individuals' anxious feelings while engaging with or anticipating mathematics-related activities, such as taking a mathematics test, attending a mathematics class, or even in carrying out everyday activities requiring calculations, such as dividing a dinner bill (Maloney & Beilock, 2012). Substantially less research has examined individual differences in academic anxiety in other domains, such as native language (L1) and second language (L2) learning. L1 anxiety (L1A) or L2 anxiety (L2A) describes the anxiety experienced when learning a language in class or when using the learned language to communicate in real-life settings outside of school (Horwitz, 2001).

Numerous studies have shown that high anxiety for a certain academic domain is associated with multiple negative achievement outcomes in the corresponding academic field. In the domain of mathematics, high MA is associated with numerous adverse outcomes including low motivation, negative attitudes towards mathematics, and low achievement (Namkung, Peng, & Lin, 2019; Ramirez, Shaw, & Maloney, 2018). Similarly, in the domains of language learning, studies have shown that individuals with higher L2A have lower L2 achievement (Azher, Anwar, & Naz, 2010; Horwitz, 2001; Saito & Samimy, 1996) and are less confident in their L2 abilities (Chastain, 1975; MacIntyre, Noels, & Clément, 1997).

One possible mechanism that may explain the lower achievement observed in students with higher anxiety is that domain-specific anxiety fosters behavioural avoidance, which, in turn, hinders students' opportunities to gain knowledge and practice skills (Hembree, 1990; Horwitz, Horwitz, & Cope, 1986; LeFevre *et al.*, 1992; MacIntyre & Charos, 1996). In support of this argument, studies have found that students with higher domain-specific anxiety exhibited more avoidance behaviours in the corresponding domain. In the domain of mathematics, students with higher MA are less likely to take advanced mathematics elective courses in high school and college, or to pursue a mathematics-related career path (Ashcraft & Kirk, 2001; Hembree, 1990; LeFevre *et al.*, 1992). In the domain of language learning, students with higher L2A skip class more often (Oxford, 1999) and are less likely to communicate in L2 with a native speaker (MacIntyre & Charos, 1996).

While this framework is useful for depicting one possible mechanism through which domain-specific anxiety may influence school achievement, these studies suffer from two main issues. First, most studies relied on cross-sectional data which provides little information regarding the temporal precedence in these developmental processes. Consequently, longitudinal studies are needed to address whether anxiety induces more learning avoidance over time. Second, many studies operationalized avoidance using 'distal outcomes', such as avoiding choosing a mathematics-related or language intensive career, taking electives, or communicating in a second language (Ashcraft & Moore, 2009; Hembree, 1990; Horwitz *et al.*, 1986; LeFevre *et al.*, 1992; MacIntyre & Charos, 1996). While these avoidance behaviours are important distal outcomes to consider, they provide little information on the academic avoidance students engage in everyday learning during which they gain basic knowledge and hone their skills. Few studies have examined students' domain-specific avoidance in compulsory educational settings where complete avoidance is not an option.

In this regard, studies on domain-general academic or test anxiety provided more insights. Several studies on behavioural disaffection in the classroom have found that students with more negative achievement emotions including boredom, frustration, sadness, and anxiety tend to exhibit more inattentive, disengaged, and unprepared behaviours in class (González, Garrido, Castro, & Rodríguez, 2015; Skinner, Furrer, Marchand, & Kindermann, 2008). Numerous other studies have operationalized academic avoidance as procrastination. They found that students with higher test anxiety procrastinated more than those with lower test anxiety when preparing for an upcoming examination or a major assignment (Cassady & Johnson, 2002; Klassen *et al.*, 2009; Milgram & Toubiana, 1999; Onwuegbuzie, 2004; Putwain, 2019; Saddler & Buley, 1999; Smith, Snyder, & Handelsman, 1982). Together, these studies suggest that higher academic or test anxiety is associated with more avoidance in classroom and in high-stake examination contexts. However, a few studies that examine the relations between academic anxiety and afterschool learning behaviours, such as doing regular homework assignments or learning tasks, suggest that students with higher academic anxiety procrastinate equally as, if not less than, their less anxious peers when completing these low-stake tasks (Milgram & Toubiana, 1999; Yerdelen, McCaffrey, & Klassen, 2016). Specifically, Milgram and Toubiana (1999) found that adolescents who were less anxious about their schoolwork procrastinated more on their homework than those with higher academic anxiety. Yerdelen *et al.* (2016) found that changes in undergraduate students' procrastination behaviours throughout the semester were not associated with changes in their levels of academic anxiety. These results contradict findings from studies on classroom and test-centred learning behaviours, which raise the question of whether the relation between academic anxiety and avoidance in learning may depend on the definition and context of avoidance.

To address these outstanding questions, the present study explored the relation between academic anxiety and learning avoidance in a large sample of high school students. First, we used a longitudinal design to examine whether academic anxiety predicted more learning avoidance over time. Second, we operationalized learning avoidance as time spent on afterschool learning (i.e., homework and out-of-school lessons). This operationalization is novel in two major ways: (1) It focuses on avoidance in everyday learning in a compulsory educational setting instead of avoidance of future academic and professional opportunities, and (2) it addresses the scarcity of research on learning avoidance in afterschool settings. Finally, instead of examining general academic or test anxiety, we investigated the associations between domain-specific anxiety and domain-specific avoidance behaviours in mathematics, L1, and L2. If higher anxiety is associated with more avoidance in learning, we would expect that students with higher academic anxiety spend less time on afterschool learning in the corresponding domain, such as spending less time doing their homework or taking additional afterschool classes.

Mental toughness as a moderator between academic anxiety and academic avoidance

Individuals may cope with their learning anxiety in drastically different ways depending on their approach versus withdrawal tendencies (Elliot & Thrash, 2002). For example, one recent study found that students with a combination of high MA and high mathematics motivation exhibit as much effort as students with low MA and high mathematics motivation (Wang, Shakeshaft, Schofield, & Malanchini, 2018), suggesting that some students with high MA may actively approach, rather than avoid, the anxiety-provoking learning situation.

In addition to domain-specific motivation, other domain-general personality characteristics, including MT, have been linked to individuals' approach versus withdrawal tendencies in learning contexts. Mental toughness is a personality attribute that allows individuals to effectively cope with and overcome adverse or stressful situations (Clough *et al.*, 2002; Gould, Hodge, Peterson, & Petlichkoff, 1987). MT is a multi-dimensional construct comprising four aspects: commitment, challenge, control, and confidence (Clough *et al.*, 2002). First, mentally tough individuals are committed – they persevere in spite of obstacles. Second, mentally tough individuals embrace challenges – they often view obstacles as opportunities rather than hurdles. Third, mentally tough individuals exert control – they hold themselves accountable for their own actions and view themselves as the most influential force that shapes their own life trajectories. Finally, mentally tough individuals are confident – they perceive themselves as worthwhile and competent (Jones, Hanton, & Connaughton, 2007).

Mental toughness has been studied extensively in athletes in highly competitive professional sports (e.g., Jones, 2002; Jones *et al.*, 2007; Mahoney, Gucciardi, Ntoumanis, & Mallet, 2013; Thelwell, Weston, & Greenlees, 2005; for a review, see Crust, 2007). In general, athletes with higher levels of MT are more likely to succeed in their own field of competition (Bell, Hardy, & Beattie, 2013; Jones *et al.*, 2007; Mahoney *et al.*, 2013). More recent studies begin to apply the MT framework in everyday educational and occupational settings (Lin, Mutz, Clough, & Papageorgiou, 2017; McGeown, St Clair-Thompson, & Clough, 2016). Consistent with the literature in sport psychology, MT is found to be positively associated with a variety of desired educational outcomes, such as higher academic achievement, higher attendance rates, and more successful transition to college

(Crust *et al*., 2014; Lin *et al*., 2017; St Clair-Thompson *et al*., 2015). Higher MT has also been found to predict less inattention, hyperactivity, and oppositional and defiant behaviours in the classroom (St Clair-Thompson *et al*., 2015).

The differences in achievement in sports and school among individuals with different levels of MT may lie in their use of different coping strategies. When confronted with difficulties and obstacles in training and competition, athletes with higher levels of MT were found to use more problem-oriented approaches, such as increased efforts, perseverance, and planning, fewer emotion-oriented strategies such as venting emotions, and fewer avoidance strategies such as behavioural disengagement and denial (Gucciardi, Peeling, Ducker, & Dawson, 2016; Kaiseler, Polman, & Nicholls, 2009; Nicholls, Polman, Levy, & Backhouse, 2008). As such, it is reasonable to hypothesize that students with high levels of MT would be more likely to apply problem-oriented approaches than to apply avoidance strategies to cope with their learning anxiety. The second aim of the present study was to investigate this possibility by examining whether MT moderates the association between academic anxiety and academic avoidance.

In summary, the present study sought to investigate the relation between academic anxiety and academic avoidance in high school across three subjects: mathematics, L1, and L2. Given the scarcity of previous research that operationalizes avoidance in afterschool learning in compulsory educational settings, we do not have a prior hypothesis regarding the direction of the relation between academic anxiety and academic avoidance. Additionally, we investigated whether MT moderated the association between academic anxiety and academic avoidance in each domain. We hypothesized that academic anxiety would predict less academic avoidance in students with high MT.

Method

Participants

Participants are part of the Multi-Cohort Investigation into Learning and Educational Success (MILES) study (https://www.projectmiles.com). MILES is an ongoing longitudinal study of high school students who reside and go to school in the Milan province in Italy. Students from three different high schools participated in the study. All schools are state, non-selective schools which students are not required to take any exams or ability tests to enroll. All schools follow a Baccalaureate curriculum such that all students take a number of core subjects, including Italian, Italian literature, mathematics, and second language. Two out of the three schools are technical high schools, which focus on subjects such as chemistry, informatics, accounting, and technical design. The third school is a Lyceum, focusing more on academically oriented subjects such as languages and sciences. Data were collected from 444 students in two waves that were one semester apart. Among these 444 students (52% female), 145 were in their first year of high school, which corresponds to the eighth grade in the United States, 134 were in their second year (9th grade), 84 were in their third year (10th grade), 42 were in their fourth year (11th grade), and 39 were in their fifth year (12th grade). The age of the students ranged from 14 to 21 years (M = 15.64, SD = 1.44). The distribution of the sample across age and school year is shown in Table S1.

Procedure

The MILES team obtained approval from each of the schools' administrations and teacher and parent committees, as well as ethical approval from Goldsmiths University of London.

Information regarding the study was disseminated to the students in conferences held at the schools and through a newsletter sent to each student. Students who consented to participate completed the study using the forepsyte.com online platform.

Measures

All measures below were collected in both waves. To investigate the longitudinal predictive effect of academic anxiety and its interaction with MT on subsequent academic avoidance, we utilized academic anxiety and MT measured in wave1 and academic avoidance measured in the wave2. In addition, to control for initial individual differences in academic achievement, academic avoidance, and general anxiety, we included these measures collected in wave1.

MA

The Abbreviated Math Anxiety Scale (AMAS; Hopko, Mahadevan, Bare, & Hunt, 2003) was used to assess how anxious or nervous the participants feel in different areas pertaining to mathematics. The AMAS scale contains nine items, rated on a 5-point Likert scale (1 = not at all nervous to 5 = very much nervous). Higher scores indicated more MA. This scale has excellent internal validity with Cronbach's alpha being .84.

L1A

The MILES team developed a measure to assess L1A (Table S2). This scale contains six items inquiring how anxious or nervous students feel in various situations related to their classes in Italian. Students were asked to report their feelings on a 5-point Likert scale (1 = not at all to 5 = very much). Example items are 'You are being assessed with a literacy composition/essay' and 'You need to read out loud in Italian'. Higher scores indicated higher L1A. This scale has good internal reliability with Cronbach's alpha being .79. As shown in the results section, this scale has good criterion validity, as it is modestly positively associated with general anxiety, MA, L2A, and modestly negatively associated with L1 achievement (Table 3).

L2A

L2A was assessed using the anxiety subscale of the L2 motivation scale developed by Csizér and Kormos (2008). Students were asked to rate how nervous they feel when they are engaged in L2 learning or L2 communication using seven items on a 5-point Likert scale (1 = not true at all to 5 = absolutely true). Higher scores indicated more anxiety. This scale has excellent internal reliability with a Cronbach's alpha of .88. If the students were learning multiple foreign languages at the same time, they were asked to think about their primary foreign language when answering questions. Examples of items are 'Even if I'm well prepared for the class, I feel anxious' and 'I'm afraid that other students will laugh at me when I speak in my foreign language'.

Mental toughness

Mental toughness was assessed using The Mental Toughness Questionnaire (MT18) (Levy, Polman, Clough, Marchant, & Earle, 2006). Students were asked to report to what extent they agree with each of the 18 statements on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Due to system errors, data on the last three items were missing. Sample items included ‘Even when under considerable pressure I usually remain calm’ and ‘I generally cope well with any problems that occur’. Higher scores indicated higher levels of MT. This scale has good internal reliability, with a Cronbach’s alpha of .75.

Academic avoidance

PISA (OCED Programme for International Student Assessment www.pisa.oecd.org) developed a scale to assess the amount of time that each student spend on a given subject. Questions were altered to address mathematics, L1, and L2, respectively. The participants were asked to rate on a 5-point scale (1 = no time to 5 = six or more hours) how much time they spend on each subject on average per week. They were asked to rate the time spent on two main activities: (1) lessons taken outside of school and (2) studying or doing homework by themselves. The two items within each subject area were significantly correlated (*r*s range from .26 to .56). Higher scores indicated less avoidance in a given subject.

Covariates

General anxiety

General anxiety was assessed using the Generalized Anxiety Disorder (GAD-7) scale, which is a 7-item scale (Löwe *et al.*, 2008). Participants were asked to rate on a 4-point Likert scale (1 = not at all to 4 = nearly every day) the frequency to which they had experienced thought, emotional, and physical problems during the past 2 weeks. Example items are ‘feeling nervous, anxious, or on edge’ and ‘worrying too much about different things’. Higher scores indicated higher anxiety levels. This scale has excellent internal reliability with Cronbach’s alpha being .89.

Academic achievement

Students self-reported their school grades in mathematics, L1, and L2 classes. School grades ranged from 4 to 10, with higher scores indicating better achievement performance.

Analytic strategy

Descriptive statistics were obtained using SPSS version 24 (IBM Corp, 2016). The main research questions were addressed using structural equation modelling in Mplus version 8.2 (Muthén & Muthén, 1998–2017). First, we used confirmatory factor analysis (CFA) to examine each of the main constructs (i.e., general anxiety, MA, L1A, L2A, MT, and academic avoidance in the three areas). Factor loadings were inspected to make sure that all items loaded adequately on the corresponding constructs (i.e., factor loadings above 0.3). Because only two items were available to measure academic avoidance in each subject area in each wave, factor loadings of these two items were constrained to be equal for the model to be identified. Additionally, an inspection of the item content within each construct suggested that there appeared to be groups of items that measured anxiety in specific contexts. For MA, three items (items 2, 4, and 8) measured exam-related MA; four items (items 3, 6, 7, and 9) measured MA associated with math learning in the classroom; the two remaining items measured MA associated with doing math homework and MA associated with using math tables. As such, correlational paths were added among residuals of the exam-related indicators and among residuals of the classroom-related indicators to capture the context-specific covariance. For L1A, three items (items 3, 5, and 6) assessed L1A about written assessments, whereas each of the remaining items, respectively, measured learning-related L1A, L1A about oral performance, and L1A about assessments in unspecified formats. Therefore, correlations were added among the residuals of the three written-assessment indicators to capture covariance unique to this context. For L2A, three items measured L2A associated with speaking L2 in front of the class (items 3, 6, and 7), one item measured L2A associated with conversing in L2 with native speakers (item 2), one item measured L2A associated with L2 class (item 1), and one item measured L2A experienced in comparison with anxiety experienced in other classes (item 5). Correlations were added among the residuals of items 3, 6, and 7 to capture covariance unique to speaking L2 in class. Next, a measurement model with all main constructs was fitted to assess the correlations among latent variables.

Model fit indices including the chi-square test statistic, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) were used to evaluate model fit. A model with a CFI value above .95, a TLI value above .95, a RMSEA value below .06, and a SRMR value below .08 is considered to have an excellent fit to the observed data (Hu & Bentler, 1999). A model with a CFI value above .90, a TLI value above .90, and a RMSEA value below .08 is considered to have an acceptable fit to the observed data (McDonald & Marsh, 1990; Yuan, 2005).

Next, to examine the longitudinal predictive effect of academic anxiety and its interaction with MT on subsequent academic avoidance, a structural equation model (SEM) was conducted in each of the three domains (Figure 1). In particular, the interaction between academic anxiety and MT on academic avoidance was examined using the latent variable interaction approach described in Klein and Moosbrugger (2000). To examine the statistical significance of the latent interaction term, we followed a two-step procedure recommended by Maslowsky, Jager, and Hemken (2015). First, we estimated the SEM without the latent interaction term (M0). Second, we estimated the SEM with the latent interaction term (M1; see Figure 1). The two models were compared using a log-likelihood ratio test, such that $-2 \times$ *(log-likelihood for M0* $-$ *log-likelihood for M1)* approximates a chi-square distribution with one degree of freedom. A significant log-likelihood ratio test means that M0 fits significantly worse than M1, which indicates that the interaction term should be retained. Once a significant latent interaction term was found, *post-hoc* analyses were conducted. Specifically, in each domain, the effect of wave1 academic anxiety on wave2 academic avoidance was investigated at high (i.e., one standard deviation above the mean), medium (i.e., the mean), and low (i.e., one standard deviation below the mean) levels of MT.

In addition to the main study variables, students' school, age, sex, wave1 general anxiety, wave1 academic achievement in each of the three domains, and wave1 academic avoidance in each of the three domains were included in the corresponding SEMs as covariates. General anxiety was included as a covariate to rule out the possibility that differences in academic avoidance are attributable to differences in general (but not domain specific) anxiety. Academic achievement was included as a covariate to rule out the possibility that differences in academic avoidance are attributable to differences in academic skills alone. Wave1 academic avoidance was included as a covariate to control

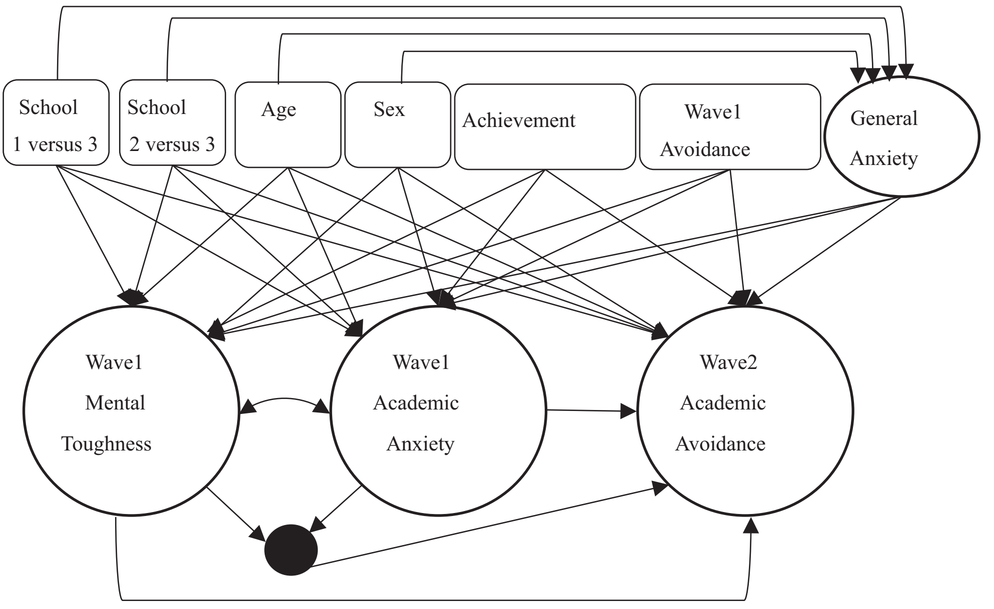

Figure 1. Structural equation models examining the predictive effects of wave1 academic anxiety, wave1 mental toughness, and their interaction on wave2 academic avoidance, controlling for covariates including students' school, age, sex, wave1 general anxiety, wave1 academic achievement, and wave1 academic avoidance. Squares represent manifest variables, and circles represent latent constructs. The filled circle represents the interaction between wave1 academic anxiety and wave1 mental toughness. Single-headed arrows represent predictive paths, and double-headed arrows represent correlations.

for individual differences in initial academic avoidance.[1] This allows us to examine the unique contribution of academic anxiety and MT on subsequent academic avoidance. All covariates were mean centered prior to analyses.

To examine the assumptions of normality, homoskedasticity, and data missing mechanism, we used the R package developed by Jamshidian, Jalal, and Jansen (2014). Results showed that the assumption of homoskedasticity and missing completely at random were met ($p = .37$), while the assumption of normality was not met ($p < .001$). As such, parameters in all models were estimated using the maximum likelihood estimator with robust standard errors, which handles missing data using full information maximum likelihood.

Results

Descriptive statistics

Descriptive statistics are shown in Table 1. All main variables were widely distributed across their respective scales. On average, students reported modest levels of anxiety in mathematics, L1, and L2, and moderate MT. Students reported an average of 2 hr of study time per week on each of the three subjects.

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[1] *Including academic avoidance in wave1 as a latent covariate produced nonpositive definite covariance matrices. As a result, academic avoidance in wave1 was included as a manifest covariate, which is computed by taking a mean of the two items within each subject area.*

Table 1. Descriptive statistics

	Mean	*SD*	Median	Minimum	Maximum	Possible range
General anxiety	1.91	0.73	1.86	1.00	4.00	1–4
Math anxiety	2.42	0.73	2.44	1.00	5.00	1–5
L1 anxiety	2.38	0.81	2.33	1.00	4.50	1–5
L2 anxiety	2.54	1.00	2.43	1.00	5.00	1–5
Mental toughness	3.20	0.50	3.20	1.60	4.67	1–5
Math time spent wave1	2.24	0.70	2.00	1.00	5.00	1–5
L1 time spent wave1	2.25	0.69	2.00	1.00	5.00	1–5
L2 time spent wave1	2.34	0.76	2.00	1.00	5.00	1–5
Math time spent wave2	2.24	0.74	2.00	1.00	5.00	1–5
L1 time spent wave2	2.25	0.71	2.00	1.00	5.00	1–5
L2 time spent wave2	2.29	0.82	2.00	1.00	5.00	1–5
Math achievement	6.42	1.46	6.00	4.00	10.00	4–10
L1 achievement	6.81	1.00	7.00	4.00	10.00	4–10
L2 achievement	6.74	1.23	7.00	4.00	9.00	4–10

Note. L1 = native language; L2 = second language; more time spent indicates less avoidance.

Confirmatory factor analyses

Confirmatory factor analysis showed that with the exception of MT, all the items for all other main constructs had adequate loadings (0.3 or above) and were retained in the final model. For MT, eight items (items 1, 4, 5, 7, 10, 13, 14, and 15) that had loadings above 0.3 were retained in the final model. Model fit indices and factor loadings for the CFA models are shown in Table 2. All measurement models, with the exception of the measurement model for MT, had acceptable fit. Next, we inspected correlations among indicators of MT to identify possible reasons for the poor fitting (Table S3). Two items (items 14 and 15) were particularly strongly correlated. An inspection of the item content suggested that both items captured the extent to which individuals focus on the bright side of challenges. A correlation was added between the residuals of these two indicators in the final measurement model for MT. This model fits the data adequately.

Correlations between latent factors were obtained in a measurement model that included all constructs. Fit statistics for this model are $\chi^2(df)$ = 2769.605 (1,059), *RMSEA* = .060, *SRMR* = .072, *CFI* = .818, and *TLI* = .797. RMSEA and SRMR indicated a good model fit. However, TLI and CFI indicated a poor model fit. One possible reason for the poor model fit is that additional correlations among residuals of indicators across constructs were not accounted for. A close examination of indicators for all constructs suggested that pairs of indicators assessed the same activity in two different domains: (1) One indicator of L1A and one indicator of MA both measured anxiety associated with starting learning a new chapter; (2) one indicator of MA and one indicator of L1A both measured anxiety experienced during a surprise quiz; (3) one indicator of L1A and three indicators of L2A measured anxiety experienced when speaking the language in front of class; (4) one indicator in each of the three domains within each wave assessed the amount of time spent on doing homework; and (5) one indicator in each of the three domains within each wave assessed the amount of time spent on taking afterschool lessons. Additional correlations were added in the measurement model between each pair of residuals in the above five sets to account for these context-specific relations. This final measurement model fits the data adequately: $\chi^2(df)$ = 1844.587 (1,033), *RMSEA* = .042,

Table 2. Confirmatory factor analyses: model fit indices, factor loadings, and standard errors

	GA	MA	L1A	L2A	MT (initial)	MT (Final)	Wave1 math time spent	Wave2 math time spent	Wave1 L1 time spent	Wave2 L1 time spent	Wave1 L2 time spent	Wave2 L2 time spent
$\chi^2(df)$	47.225 (14)	39.063 (18)	10.048 (6)	31.523 (11)	120.671 (20)	40.560 (19)	0.000 (0)	0.000 (0)	0.000 (0)	0.000 (0)	0.000 (0)	0.000 (0)
RMSEA	.075	.052	.040	.066	.107	.052	–	–	–	–	–	–
SRMR	.031	.031	.025	.026	.057	.033	–	–	–	–	–	–
CFI	.969	.980	.993	.980	.850	.968	–	–	–	–	–	–
TLI	.953	.961	.983	.961	.791	.953	–	–	–	–	–	–
Indicator 1	0.80 (0.04)	0.38 (0.07)	0.74 (0.06)	0.66 (0.04)	0.52 (0.05)	0.52 (0.05)	0.56 (0.06)	0.63 (0.05)	0.45 (0.07)	0.52 (0.06)	0.63 (0.06)	0.74 (0.05)
Indicator 2	0.87 (0.04)	0.68 (0.07)	0.43 (0.06)	0.60 (0.04)	0.74 (0.05)	0.77 (0.05)	0.56 (0.06)	0.63 (0.05)	0.45 (0.07)	0.52 (0.06)	0.63 (0.06)	0.74 (0.05)
Indicator 3	0.86 (0.04)	0.77 (0.08)	0.61 (0.06)	0.71 (0.04)	0.60 (0.05)	0.60 (0.05)						
Indicator 4	0.75 (0.05)	0.71 (0.07)	0.41 (0.06)	0.77 (0.04)	0.37 (0.07)	0.37 (0.07)						
Indicator 5	0.60 (0.05)	0.77 (0.07)	0.56 (0.07)	0.74 (0.04)	0.72 (0.05)	0.73 (0.05)						
Indicator 6	0.65 (0.05)	0.55 (0.06)	0.75 (0.05)	0.86 (0.03)	0.57 (0.06)	0.59 (0.06)						
Indicator 7	0.63 (0.06)	0.47 (0.07)		0.59 (0.05)	0.61 (0.06)	0.53 (0.05)						
Indicator 8		0.53 (0.07)			0.60 (0.06)	0.52 (0.05)						
Indicator 9		0.72 (0.07)										

Note. CFI = comparative fit index; *df* = degrees of freedom; GA = general anxiety; L1 = native language; L2 = second language; MA = mathematics anxiety; MT = mental toughness; RMSEA = the root mean square error of approximation; SRMR = Standardized Root Mean Square; TLI = Tucker-Lewis Index.
Model fit indices were not estimated for academic avoidance, because these measurement models were just identified.

SRMR = .059, *CFI* = .913, and *TLI* = .901. The estimated correlations between each pair of latent factors are shown in Table 3. Mathematics, L1, and L2 anxiety were modestly and positively associated with one another. Mental toughness was negatively associated with academic anxiety in all three areas. Higher MA and L2A were associated with more time spent (i.e., less academic avoidance) in mathematics and L2, respectively. L1A was not associated with time spent in L1. Higher MT was modestly negatively associated with less time spent in all three domains. Finally, time spent on afterschool learning was moderately stable within each domain and moderately positively correlated between domains.

Structural equation models

Model fit indices for SEMs without the interaction effect in each domain are shown in Table S4. RMSEA and SRMR indicated an excellent fit, whereas CFI and TLI indicated a poor fit. To identify sources of misfit, we first ran a simpler model without the covariates within each domain. As shown in Table S4, these models fit the data well. These results suggested two possible reasons underlying the poor fit of the proposed models: (1) Many covariates did not significantly predict all the main constructs, resulting in non-parsimonious models, and (2) additional effects of covariates on residuals of indicators were not accounted for. Therefore, we first constrained all the non-significant predictive effects of covariates at zero. Then, we inspected the correlations among covariates and indicators of the main constructs, aiming to identify the condition in which a covariate did not significantly predict a latent construct, but it was correlated with selected indicators of that latent construct at a medium effect size or above (i.e., an $|r|$ of approximately .3 or above). Two such correlations were identified, between sex and one indicator of MT (item 1; $r = .32$) and between mathematics achievement and one indicator of mathematics avoidance (item 1; $r = -.29$). The predictive effect of sex on the residual of MT item 1 was added in the SEMs in all three domains, and the predictive effect of mathematics achievement on avoidance item 1 was added in the SEM in mathematics. Fit indices (Table 4) suggested that these modified models generally fit the data adequately. Additionally, according to the likelihood ratio test, the model without the interaction

Table 3. Bivariate correlations between latent factors

	1	2	3	4	5	6	7	8	9	10
1. General anxiety	–									
2. Math anxiety	.45*	–								
3. L1 anxiety	.23*	.23*	–							
4. L2 anxiety	.28*	.23*	.35*	–						
5. Mental toughness	−.47*	−.33*	−.29*	−.19*	–					
6. Math time spent wave1	.21*	.29*	.11	.06	−.24*	–				
7. L1 time spent wave1	.19*	.33*	.11	.01	−.08	.58*	–			
8. L2 time spent wave1	.21*	.25*	.13	.02	−.15*	.56*	.43*	–		
9. Math time spent wave2	.20*	.29*	.12	.10	−.15*	.72*	.65*	.49*	–	
10. L1 time spent wave2	.17*	.18*	.03	.13	−.19*	.45*	.86*	.35*	.46*	–
11. L2 time spent wave2	.13*	.31*	.09	.13*	−.20*	.41*	.43*	.50*	.48*	.63*

Note. L1 = native language; L2 = second language; more time spent indicates less avoidance.
*Statistical significance under the pre-specified type I error rate of .05.

effect fits significantly worse than the model with the interaction effect in mathematics and L1, suggesting that MT moderated the predictive effect of academic anxiety on wave2 avoidance in these two domains. In L2, model comparison suggested a trend for the moderation effect (p = .06).

Unstandardized path estimates, their standard errors, and 95% confidence intervals from SEMs with the interaction effect in each domain are shown in Table 5. Pertaining to our main research questions, first, academic anxiety did not predict wave2 academic avoidance in any of the three domains after controlling for the effects of covariates including students' school, age, sex, general anxiety, academic achievement, and wave1 academic avoidance. Second, the interaction term was statistically significant in the domains of mathematics and L1. There was a trend for the interaction effect in L2 (p = .06). The interaction term accounted for 4%, 6%, and 2% of the variance in wave2 academic avoidance in mathematics, L1, and L2, respectively.

To examine the interaction between academic anxiety and MT in each domain, *post-hoc* analyses were conducted. The effects of academic anxiety on wave2 academic avoidance in each domain were plotted at one standard deviation above the mean (high), the mean (medium), and one standard deviation below the mean (low) of MT. The results are shown in Figure 2. Figure 2a–c, respectively, presents results from *post-hoc* analysis in mathematics, L1, and L2. In all three domains, higher academic anxiety was significantly associated with more time spent in the corresponding subject only in students with high MT. In students with medium and low MT, academic anxiety was not significantly associated with time spent in afterschool learning in any of the three domains.

Table 4. Model fit indices for structural equation models

	Mathematics		L1		L2	
	M0	M1	M0	M1	M0	M1
Log-likelihood	−13306.434	−13302.959	−11946.405	−11941.722	−12776.253	−12774.573
Number of free parameters	103	104	88	89	87	88
AIC	26818.868	26813.918	24068.810	24061.445	25726.507	25725.145
aBIC	26909.618	26905.549	24146.344	24139.860	25803.160	25802.679
−2LL	–	6.950*	–	9.366*	–	3.36†
ΔAIC	–	4.950	–	7.365	–	1.362
ΔaBIC	–	4.069	–	6.484	–	0.481
RMSEA	.046	–	.048	–	.049	–
SRMR	.064	–	.073	–	.062	–
CFI	.913	–	.901	–	.914	–
TLI	.902	–	.890	–	.904	–
R^2	.34	.38	.44	.50	.26	.28
ΔR^2	–	.04	–	.06		.02

Note. ΔAIC/ΔaBIC = AIC/aBIC change from M0 to M1; ΔR^2 = additional variance in wave2 avoidance explained by the interaction term; −2LL = −2 × (M0 log-likelihood − M1 log-likelihood); aBIC = sample size adjusted Bayesian information criterion; AIC = Akaike information criterion; CFI = Comparative Fit Index; M0 = SEM without the interaction effect; M1 = SEM with the interaction effect; R^2 = total variance in wave2 avoidance accounted for by all predictors; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square; TLI = Tucker-Lewis Index.
*M0 fits significantly worse than M1 under the pre-specified type I error rate of .05.; †p = .06.

Discussion

The current study first investigated whether students with higher academic anxiety engaged in more avoidance in afterschool learning in high school in three subject areas: mathematics, L1, and L2. Using a longitudinal design, our findings did not support the notion that higher academic anxiety leads to a greater degree of avoidance in learning in all students (Hembree, 1990; Horwitz *et al.*, 1986; LeFevre *et al.*, 1992). Instead, we found that after controlling for differences in initial academic achievement and academic avoidance, students with high academic anxiety did not differ from their low anxiety counterparts in their academic avoidance in any of the three domains.

The unique operationalization of learning avoidance used in the present study likely contributed to the discrepancy between the current results and other findings in the existing literature. Extant literature on domain-specific anxiety has mostly defined avoidance in more distal and optional settings, such as not pursuing a math related career, not taking advanced electives, or not communicating in L2 (Hembree, 1990; Horwitz *et al.*, 1986; LeFevre *et al.*, 1992; MacIntyre & Charos, 1996). Other studies on domain general or test anxiety mostly focused on in-class or test-related learning avoidance. In contrast, we investigated domain-specific learning that occurred outside of school in a compulsory educational setting by operationalizing learning avoidance as the amount of time spent on afterschool learning in a given academic domain. Students who are anxious about a school subject may choose to do as little of it as possible when there is a viable alternative path (e.g., whether to pursue a degree in computer science or language arts; Hembree, 1990; MacIntyre & Charos, 1996). Students who are anxious about a school subject may also choose to engage in self-handicapping strategies (e.g., procrastinate) in a high-stake context to avoid negative evaluations that may damage one's academic self-esteem (Cassady & Johnson, 2002; Klassen *et al.*, 2009). However, our finding resonates with several studies that revealed a null or negative association between domain-general academic anxiety and procrastination on homework assignments or regular learning tasks (Milgram & Toubiana, 1999; Yerdelen *et al.*, 2016). Together, these findings may suggest that academically anxious students do not necessarily avoid learning more than their non-anxious counterparts do in their daily, low-stake, task-oriented learning environment. Some studies even suggest that academically anxious students may engage in compensatory effort in low-stake tasks to reduce their anxiety (Milgram & Toubiana, 1999). This argument is also in line with the attentional control theory (ACT), which posits that anxious individuals often endorse approach-oriented strategies to ensure good performance on laboratory tasks (Eysenck, Derakshan, Santos, & Calvo, 2007). The ACT argues that anxiety adversely impacts performance efficiency by impairing goal-driven attention required for cognitive tasks (Eysenck *et al.*, 2007). As a result, individuals with high anxiety often endorse alternative strategies, such as increased effort and use of additional cognitive resources, to compensate for their impaired cognitive capacities in real-time during testing (Eysenck *et al.*, 2007; Hadwin, Brogan, & Stevenson, 2005; Smith, Bellamy, Collins, & Newell, 2001).

We also found that MT moderated the relations between academic anxiety and academic avoidance. Among those with high levels of MT, students with higher anxiety reported less avoidance than their less anxious peers did in studying mathematics, L1, and L2 after school. However, anxious students with low levels of MT did not differ from their non-anxious peers in their time spent on afterschool learning. Extant literature has shown that mentally tough individuals are hardworking and responsible (Clough *et al.*, 2002). They tend to use more approach-oriented strategies such as increased efforts and

Table 5. Path estimates from structural equation models: academic anxiety, mental toughness, and their interaction predict academic avoidance

			Mathematics		L1		L2	
			B (*SE*)	95% CI	*B* (*SE*)	95% CI	*B* (*SE*)	95% CI
School 1 versus 3	→	General anxiety	–	–	–	–	–	–
School 2 versus 3	→	General anxiety	–	–	–	–	–	–
Age	→	General anxiety	0.14 (0.04)*	(0.07, 0.21)	0.14 (0.04)*	(0.07, 0.21)	0.14 (0.04)*	(0.07, 0.22)
Sex (0 = F; 1 = M)	→	General anxiety	−0.62 (0.11)*	(−0.82, −0.41)	−0.62 (0.11)*	(−0.83, −0.41)	−0.62 (0.11)*	(−0.82, −0.41)
School 1 versus 3	→	Academic anxiety	−0.70 (0.16)*	(−1.01, −0.39)	−0.58 (0.17)*	(−0.90, −0.25)	–	–
School 2 versus 3	→	Academic anxiety	–	–	−0.36 (0.07)*	(−0.50, −0.21)	–	–
Age	→	Academic anxiety	−0.14 (0.06)*	(−0.25, −0.02)	–	–	–	–
Sex (0 = F; 1 = M)	→	Academic anxiety	−0.41 (0.19)*	(−0.77, −0.04)	–	–	−0.42 (0.12)*	(−0.65, −0.19)
General anxiety	→	Academic anxiety	0.49 (0.09)*	(0.32, 0.66)	0.26 (0.07)*	(0.13, 0.40)	0.25 (0.06)*	(0.13, 0.37)
Wave1 time spent	→	Academic anxiety	–	–	–	–	–	–
Achievement	→	Academic anxiety	−0.26 (0.05)*	(−0.36, −0.16)	−0.21 (0.06)*	(−0.33, −0.08)	−0.46 (0.06)*	(−0.57, −0.36)
School 1 versus 3	→	Mental toughness	–	–	–	–	–	–
School 2 versus 3	→	Mental toughness	–	–	–	–	–	–
Age	→	Mental toughness	0.09 (0.04)*	(0.01, 0.17)	0.09 (0.04)*	(0.01, 0.17)	0.10 (0.04)*	(0.01, 0.18)
Sex (0 = F; 1 = M)	→	Mental toughness	–	–	–	–	–	–
General anxiety	→	Mental toughness	−0.48 (0.09)*	(−0.66, −0.31)	−0.50 (0.09)*	(−0.68, −0.32)	−0.50 (0.09)*	(−0.68, −0.33)
Wave1 time spent	→	Mental toughness	−0.17 (0.08)*	(−0.33, −0.00)	–	–	–	–
Achievement	→	Mental toughness	–	–	0.26 (0.06)*	(0.13, 0.38)	–	–
School 1 versus 3	→	Wave2 time spent	–	–	–	–	–	–
School 2 versus 3	→	Wave2 time spent	–	–	–	–	–	–
Age	→	Wave2 time spent	–	–	0.18 (0.07)*	(0.03, 0.32)	–	–
Sex (0 = F; 1 = M)	→	Wave2 time spent	–	–	–	–	–	–
General anxiety	→	Wave2 time spent	–	–	–	–	–	–
Wave1 time spent	→	Wave2 time spent	1.03 (0.16)*	(0.71, 1.36)	1.22 (0.30)*	(0.63, 1.80)	0.74 (.13)*	(0.50, 0.99)
Achievement	→	Wave2 time spent	–	–	0.25 (0.10)*	(0.05, 0.45)	–	–
Academic anxiety	→	Wave2 time spent	0.11 (0.08)	(−0.05, 0.26)	0.00 (0.12)	(−0.24, 0.25)	0.10 (0.06)	(−0.02, 0.22)

Continued

Table 5. (*Continued*)

			Mathematics		L1		L2	
			B (*SE*)	95% CI	*B* (*SE*)	95% CI	*B* (*SE*)	95% CI
Mental toughness	→	Wave2 time spent	0.01 (0.08)	(−0.15, 0.17)	−0.19 (0.12)	(−0.42, 0.04)	−0.13 (0.07)	(−0.26, 0.00)
Latent interaction	→	Wave2 time spent	0.14 (0.06)*	(0.02, 0.26)	0.28 (0.12)*	(0.05, 0.51)	0.09 (0.05) †	(−0.00, 0.19)
Academic anxiety		Mental toughness	−0.13 (0.07)	(−0.28, 0.01)	−0.19 (0.07)*	(−0.32, −0.06)	−0.04 (0.07)	(−0.17, 0.09)

Note. Paths indicated by '–' have been constrained to 0.
B = unstandardized path estimates; CI = confidence interval; L1 = native language; L2 = foreign language; more time spent indicates less avoidance; *SE* = standard errors.
*Statistical significance under the pre-specified type I error rate of .05.; †p = .06.

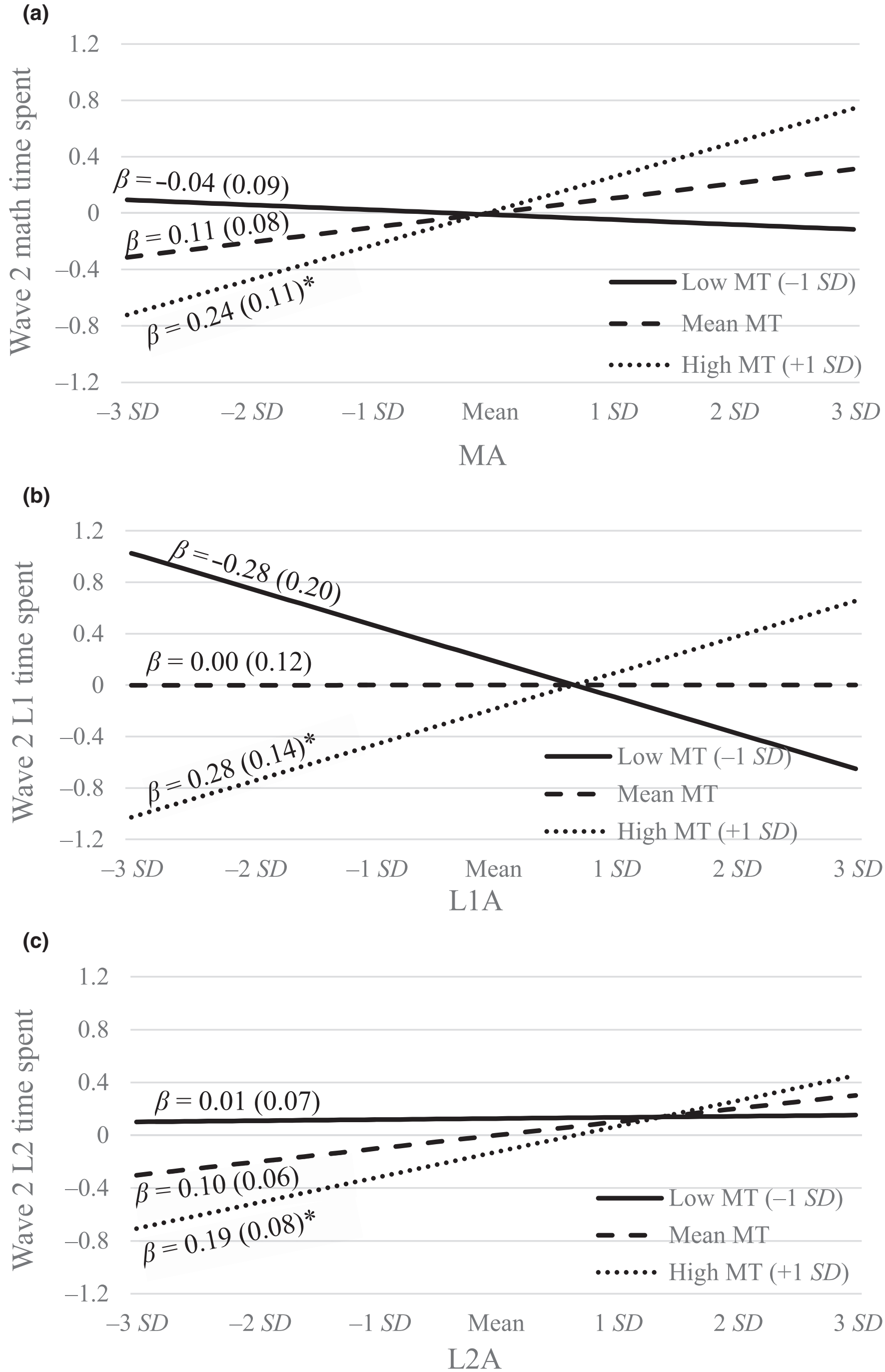

Figure 2. *Post-hoc* analyses: Predictive effect of academic anxiety on academic avoidance in (a) mathematics, (b) L1, and (c) L2 at one standard deviation above the mean, the mean, and one standard deviation below the mean of mental toughness. A higher Y value represents more time spent on learning (i.e., less avoidance) in each of the three domains. β represents simple slope estimates, with the numbers in parentheses being standard errors. *Statistical significance under the pre-specified type I error rate of .05.

perseverance, and fewer withdrawal strategies such as avoidance, to cope with challenges (Gucciardi *et al.*, 2016; Kaiseler *et al.*, 2009; Nicholls *et al.*, 2008). The present findings are in line with this literature. When experiencing anxiety in learning, students high on MT may try to deal with this negative emotion by employing alternative strategies (e.g., extended study time and sessions) than turning away. Note that the MT measure used in the present study is domain general. It is possible that students may exhibit different levels of MT in different academic domains. Future development of domain-specific MT measures may bring more nuanced insights into the unique ways in which MT, anxiety, and avoidance interact in each academic domain.

An alternative explanation to the negative relation between academic anxiety and academic avoidance in mentally tough students is that anxious students need more time than non-anxious students to complete the same amount of work, because they have poorer academic skills. This alternative account is unlikely, given that higher academic anxiety predicted lower academic avoidance in mentally tough students even after differences in students' academic achievement were controlled. Therefore, the differences in academic emotion, rather than the differences pertaining to academic skills, likely drive the differences in academic avoidance between anxious and non-anxious students.

The extant literature presents some inconsistent findings in the relation between academic anxiety and avoidance. The educational literature typically reports that higher academic anxiety is associated with more academic avoidance (Ashcraft & Kirk, 2001; Hembree, 1990; LeFevre *et al.*, 1992; MacIntyre & Charos, 1996; Oxford, 1999). To the contrary, the cognitive literature argues that highly anxious individuals often endorse more approach-oriented strategies, such as increased effort, during tasks that involve anxiety-provoking stimuli (Eysenck *et al.*, 2007; Hadwin *et al.*, 2005; Smith *et al.*, 2001). Our study reveals several possible explanations for these inconsistencies. First, the relation between anxiety and avoidance behaviours may depend on the context in which avoidance is operationalized. Is avoidance a possible and optimal option? Is avoidance assessed in a high-stake context? Will the relief or other positive outcomes outweigh the negative consequences associated with avoidance? Second, the relation between anxiety and avoidance behaviours may depend on individual differences in coping styles. In individuals who habitually cope with anxiety using approach-oriented strategies (e.g., mentally tough individuals), anxiety may be associated with less, rather than more, avoidance.

Despite the finding that mentally tough students with higher academic anxiety spent more time on learning these subjects after school, students with higher academic anxiety are shown consistently to have lower achievement in these domains (Hembree, 1990; Horwitz, 2001; Namkung *et al.*, 2019). That is, the amount of time spent on learning a subject out of school does not seem to be translating to better achievement outcomes. In the present study, we operationalized academic avoidance with only the amount of time, but not the quality of time, students spend in each academic domain. A student may spend more time on a given subject, but s/he may not necessarily be using their time effectively. As highlighted by the ACT, individuals with high levels of anxiety are often less able to maintain goal-driven attention. As a result, it often requires them to invest in much more effort and resources in order to achieve at levels similar to their non-anxious counterparts (Eysenck *et al.*, 2007). In order to connect academic avoidance with achievement, it is critical to understand whether students apply the correct strategies in learning and practice, seek help when needed, and utilize their study time efficiently and effectively. As such, future studies should address the quality of time students with academic anxiety spend on learning, such as their levels of learning engagement (e.g., emotional, cognitive, behavioural, and social levels; Wang, Fredricks, Ye, Hofkens, & Linn, 2016).

One limitation of the present study is that only two items were available to measure the quantity of time students spent on afterschool learning in each domain. Future studies should utilize instruments with more items to investigate whether the present findings are replicable in more diverse afterschool learning activities, which may include quality of afterschool learning and engagement in high-stake tasks such as preparing for examinations and major assessments (e.g., Cassady & Johnson, 2002; Klassen *et al.*, 2009; Milgram & Toubiana, 1999; Onwuegbuzie, 2004; Putwain, 2019; Saddler & Buley, 1999; Smith *et al.*, 1982). Another limitation is the lack of measure on the quality of time students spend on learning. Future studies incorporating measures such as cognitive and emotional engagement in learning will advance our understanding of the learning behaviours in students with academic anxiety in compulsory settings. The sole reliance on self-report is also a limitation of the present study. Future studies would benefit from using multi-informant measures, such as a combination of parental, teacher, and self-report on academic avoidance. Additionally, given that most students in the present sample reported low to moderate levels of anxiety, results may not generalize to populations with extremely high levels of anxiety. Finally, the current longitudinal design relied on two waves of assessment that were only one semester apart. Such a design does not allow us to observe the long-term developmental patterns and transitions across school years. Multi-wave long-term longitudinal designs are needed to address this limitation.

Overall, our findings suggest that, in a general school population with low to moderate levels of academic anxiety, students with a combination of high academic anxiety and high MT engaged in less avoidance in afterschool learning in the domains of mathematics, L1, and L2 in compulsory educational settings. The lower achievement observed in students with higher academic anxiety is unlikely a result of complete learning avoidance at the behavioural level. Future studies should focus more on understanding the methods and strategies employed by anxious students, in order to improve the quality of time students spend on learning.

Acknowledgements

We gratefully acknowledge all the students and teachers of the Istituto Tecnico S. Cannizzaro, Istituto Tecnico E. Matteri, Liceo C. Rebora, and Liceo Scientifico E. Majorana in the city of Rho (Milan). We are particularly grateful to the principals and teachers Elena Barducci, Rita Loffredo, Nadia Boldrin, and Cosimo Morrone for their continuous support with the MILES project.

Conflicts of interest

All authors declare no conflict of interest.

Author contributions

Leslie Monique Hasty, M.S. (Conceptualization; Formal analysis; Writing – original draft; Writing – review and editing); Margherita Malanchini (Data curation; Project administration; Writing – review and editing); Nicholas Shakeshaft (Project administration; Software; Writing – review and editing); Kerry Schofield (Project administration; Software; Writing –

review and editing); Maddalena Malanchini (Project administration; Writing – review and editing); Zhe Wang (Conceptualization; Formal analysis; Supervision; Writing – original draft; Writing – review and editing).

Data availability statement

Data are available upon completing the collaboration request form at http://www.projectmiles.com/research.html.

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Received 15 October 2019; revised version received 10 June 2020

Supporting Information

The following supporting information may be found in the online edition of the article:

Table S1. Distribution of the sample across age and school year.
Table S2. Language anxiety scale.
Table S3. Mental toughness: item-level correlations.
Table S4. Model fit indices for structural equation models.