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International note: Prediction of mathematics work ethic and performance from behavioral, normative, and control beliefs among Qatari adolescents

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ABSTRACT

Over half-a-million adolescents take part in each cycle of the Program for International Student Assessment (PISA). Yet often, researchers and policy makers across the globe tend to focus their attention primarily on the academic trajectories of adolescents hailing from highly successful education systems. Hence, a vast majority of the adolescent population who regionally and globally constitute the 'long tail of underachievement' often remain unnoticed and underrepresented in the growing literature on adolescents' academic trajectories. The present study, therefore, explored the relations of dispositions toward mathematics, subjective norms in mathematics, and perceived control of success in mathematics to mathematics work ethic as well as mathematics performance; and the mediational role of mathematics work ethic in the association between dispositional, normative, and control beliefs and mathematics performance among adolescents in one of the lowest performing education systems, Qatar. Structural equation modeling (SEM) analyses revealed that Qatari adolescents' dispositional, normative, and control beliefs about mathematics were significantly associated with their mathematics work ethic and mathematics performance, and mathematics work ethic significantly mediated the relationship between dispositional, normative, and control beliefs about mathematics and mathematics performance. However, multi-group SEM analyses indicated that these relationships were not invariant across the gender and the SES groups.

The number of countries participating in the international student assessments, such as the Program for International Student Assessment (PISA), has grown exponentially over the past few years. Slightly over half a million young adolescents, representing approximately 28 million 15-year-olds from across the globe, took part in the latest cycle of PISA alone (OECD, 2014). PISA, held triennially, primarily assesses 15-year-old students' knowledge and skills in reading, mathematics, and science as well as their dispositions toward these three academic domains (OECD, 2014). The findings of the various cycles of

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PISA have demonstrated glaring differences in adolescent student achievement and engagement between countries with diverse characteristics (see Prenzel, Kobarg, Schöps, & Rönnebeck, 2013; Stacey & Turner, 2015). The lion's share of the recent research on factors contributing to adolescent students' academic achievement and engagement, however, has focused predominantly on adolescent students hailing from 'successful education systems' (e.g., Areepattamannil, Chiam, Lee, & Hong, 2015; Areepattamannil, Freeman, & Klinger, 2011; Areepattamannil & Kaur, 2012, 2013a, 2013b; Lay, Areepattamannil, Ng, & Hoon, 2015).

Moreover, the vast majority of educational and psychological research to date explaining the factors contributing to adolescents' school engagement and performance has employed diverse theoretical frameworks to better understand their academic engagement and performance (see Christenson, Reschly, & Wylie, 2012; Wentzel, Wigfield, & Miele, 2009). One of the underutilized theories in investigating differences in adolescent academic engagement and performance, although profusely used in other realms of empirical inquiry in psychology (see Armitage & Conner, 2001), is the theory of planned behavior (TPB; Ajzen, 1991, 2005). The TPB, an extension of the theory of reasoned action (Fishbein & Ajzen, 1975), postulates that an individual's intention to perform a behavior—the central determinant of one's behavior—is influenced by behavioral (i.e., attitudes: favorable or unfavorable evaluations of a given behavior), normative (i.e., subjective norms: perceived social pressure to perform or not to perform a given behavior), and control (i.e., perceived behavioral control: perceived ease or difficulty of performing a given behavior) beliefs (Ajzen, 1991, 2005). The TPB also posits that perceived behavioral control predicts not only the behavioral intention but also the behavior (Ajzen, 1991, 2005). A substantial body of research has documented the efficacy of the TPB in predicting a variety of outcomes (see Armitage & Conner, 2001; for a review).

Guided by Ajzen's TPB framework, the present study aimed at developing a more comprehensive model to account for the individual-level factors contributing to the mathematics performance of adolescents in one of the lowest performing education systems, Qatar (see Areepattamannil, 2012; Areepattamannil, Melkonian, & Khine, 2015). Specifically, this study aimed to examine the direct effects of dispositions toward mathematics, subjective norms in mathematics, and perceived control of success in mathematics on mathematics work ethic and mathematics performance; and the indirect effects of these behavioral/dispositional, normative, and control beliefs about mathematics on mathematics performance via mathematics work ethic. Although a substantial body of research has explored the associations of behavioral/dispositional, normative, and control beliefs with academic performance (see Winne & Nesbit, 2010; for a review), only very few studies have investigated the relations of such beliefs to academic work ethic (e.g., Moreira, Dias, Vaz, & Vaz, 2013). Moreover, to the best of our knowledge, there are no studies to date which examined the mediational role of mathematics work ethic in the association between behavioral/dispositional, normative, and control beliefs and mathematics performance. Such an inquiry is warranted, given the positive associations of behavioral/dispositional, normative, and control beliefs with both academic work ethic and performance (see Areepattamannil et al., 2015; Moreira et al., 2013; Winne & Nesbit, 2010). Furthermore, a more comprehensive and integrated model may not only permit us to simultaneously assess the relationships among these theoretically and conceptually interrelated constructs but also to compare the relative predictive strengths of these constructs.

The present study hypothesized that Qatari adolescents' behavioral/dispositional, normative, and control beliefs about mathematics would be significantly and positively associated with their mathematics work ethic as well as mathematics performance; and their mathematics work ethic would significantly and positively mediate the relations between behavioral/dispositional, normative, and control beliefs about mathematics and mathematics performance. We also hypothesized that these associations would be invariant across gender and SES groups.

Method

Data for the study were drawn from the fifth cycle of the PISA assessment (http://pisa2012.acer.edu.au). A total of 4975 native-born adolescents (male = 2412, female = 2563; Mean age = 15.78 years) from 145 schools took part in the fifth cycle of PISA from Qatar.

The behavioral/dispositional measures included intrinsic motivation to learn mathematics (4 items; e.g., "I do mathematics because I enjoy it"; Cronbach's $\alpha = .88$), instrumental motivation to learn mathematics (4 items; e.g., "I will learn many things in mathematics that will help me get a job"; Cronbach's $\alpha = .89$), mathematics self-efficacy (8 items; e.g., "I feel confident in understanding graphs presented in newspapers"; Cronbach's $\alpha = .88$), and mathematics self-concept (5 items; e.g., "I learn mathematics quickly"; Cronbach's $\alpha = .74$). These dispositional measures had a composite reliability of .85.

Subjective norms in mathematics (6 items; e.g., "Most of my friends do well in mathematics"; Cronbach's $\alpha = .80$) and perceived control of success in mathematics (6 items; e.g., "Whether or not I do well in mathematics is completely up to me"; Cronbach's $\alpha = .72$) constituted the subjective norm and the perceived behavioral control measures, respectively. The mathematics work ethic measure comprised nine items (e.g., "I work hard on my mathematics homework"; Cronbach's $\alpha = .91$), and the mathematics performance measure included 110 items (Cronbach's $\alpha = .90$). All items, except the cognitive items assessing mathematics performance, were on a 4-point Likert-type scale. The PISA mathematics test items were a mixture of selected response and constructed response items (OECD, 2014). In addition to these measures, gender (female = 1, male = 2) and family SES (i.e., the PISA index of economic, social, and cultural status, an index of SES derived from parental occupation, parental education, and home possessions; see OECD, 2014; low SES = 1, high SES = 2) were used in the multigroup structural equation models. OECD (2014) constructed all of these measures employing item response theory (IRT) scaling techniques.