Journal of Humanities and Social Sciences Studies
ISSN: 2663-7197
DOI: 10.32996/jhsss
Journal Homepage: www.al-kindipublisher.com/index.php/jhsss

JHSSS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Expected Occupation Status, Math Anxiety and Performance: A Cross-National Multilevel Analysis of PISA 2022

Yi Wang
Department of Psychology, Guangxi Normal University, Guilin 541004, China
Corresponding Author: Yi Wang, **E-mail**: yiwangpsy@163.com

| ABSTRACT
Adolescents' future-oriented occupational aspirations play a pivotal role in shaping educational outcomes, and are related to their educational trajectories and socio-economic achievements. Students who envision high-status careers often exhibit stronger intrinsic motivation to master challenging subjects like math. However, math anxiety may impair working memory capacity and result in diminished in math performance. Cultural context plays a significant role in shaping students' expected occupational status and math achievement, including performance in math. This study utilized a cross-cultural survey dataset covering 199,018 15-year-old adolescents from 53 countries to explore the relationship between the expected occupation status (BSMJ) of adolescents and their math anxiety as well as math performance. And explored the moderating effect of flexibility-monumentalism (FM) at the national level. The results show that: (1) BSMJ significantly predicts math performance. Importantly, these associations are stronger in higher flexibility countries. (2) BSMJ significantly predicts math anxiety and these associations are stronger in higher monumentalism countries. (3) Math anxiety significantly predicts math performance and these associations are also stronger in higher monumentalism countries. The study has implications for global education policy, particularly in designing systems that better support aspiration-actualization pathways for youth across diverse sociocultural contexts.

| KEYWORDS

Expected Occupation Status; Math Anxiety; Math Performance, Flexibility-Monumentalism, PISA2022.

| ARTICLE INFORMATION

ACCEPTED: 19 July 2025 **PUBLISHED:** 14 August 2025 **DOI:** 10.32996/jhsss.2025.7.8.3

1. Introduction

Individual differences in temporal orientation—toward the past, present, or future—can profoundly shape motivation, cognition, and emotion (Zimbardo & Boyd, 1999; Pawlak & Moustafa, 2023). Among adolescents, future-oriented thinking is especially important, including career paths and academic trajectories. In the expectancy-value framework, career expectations are driven by both perceived competence and subjective task value, which in turn affect academic behavior and performance (Lauermann et al., 2017). Higher career aspirations are consistently associated with better academic outcomes, especially in math, a domain often linked to prestige and future income (Lauermann et al., 2017; Seginer & Shoyer, 2012; Nurmi, 1991).

Compared to other subjects, mathematics might be more challenging for a larger proportion of students worldwide (Wang & Wang, 2023). Despite high aspirations, barriers such as math anxiety—can undermine math performance (OECD, 2019). Math anxiety negatively correlates with math achievement and serves as a psychological barrier to fulfilling occupational goals that require strong quantitative skills (Semeraro et al., 2020; Zhou et al., 2020). Studies have shown that students who experience anxiety about math are less confident, avoid math-related tasks, and are less likely to pursue STEM careers (Lauermann et al., 2017; Christy & Mythili, 2020). Moreover, cultural and societal contexts shape the way youth formulate and act on occupational expectations. For example, Minkov and Kaasa's (2022) flexibility–monumentalism index reflects cultural variation in how societies encourage adaptation versus adherence to traditions. Students in flexible cultures may be more open to adjusting their

aspirations based on perceived opportunity structures, whereas those in monumental cultures may adopt more rigid and idealized occupational goals (Minkov & Kaasa, 2022).

Therefore, understanding the interplay between adolescents' expected occupational status, emotional factors like math anxiety, math outcomes, and cultural context offers a multidimensional perspective on youth development. This aligns closely with Zimbardo's later work on how temporal framing shapes human thought and behavior—not as fleeting mental states but as core components of personality (Zimbardo & Boyd, 1999). This study seeks to examine these relationships using PISA 2022 data, situating findings within both psychological theory and cross-national cultural variation.

1.1. BSMJ and Math Performance

Future-oriented thinking and clear occupational goals tend to increase students' academic engagement and persistence, especially in cognitively demanding subjects such as math (Trommsdorff et al, 1979). Students' expected occupational status, such as the BSMJ variable in PISA (based on ISEI codes), has been found to be a meaningful predictor of math performance, including math achievement (OECD, 2019; Lauermann et al., 2017). According to expectancy-value theory, adolescents' academic motivation and achievement are influenced by their expectations for future success and the value they attach to academic tasks, which are shaped by anticipated career paths (Eccles & Wigfield, 2002). In addition, students with a strong future time perspective are more likely to value performance as a step toward their occupational goals. Such students are less likely to engage in risky behaviors and more likely to engage in future-oriented planning, both of which correlate positively with academic success, particularly in math (Bowles, 2008). Future orientation also predicts students' perceptions of the utility of math, which is a critical factor in subject-specific academic achievement (Nurmi, 1989). When students see math as central to reaching their career goals, they are more likely to persist in math courses and achieve higher scores. In contrast, students with vague or low-status occupational expectations tend to display lower math learning motivation, leading to poorer math outcomes.

1.2. BSMJ, Math anxiety and Math Performance

From the perspective of expectancy–value theory, math anxiety tends to arise when students highly value success in math but have low expectations for their ability, leading to emotional conflict and stress (Eccles & Wigfield, 2002; Selkirk et al., 2011; Semeraro et al., 2020; Zhou et al., 2020). In this framework, students who aim for high-status careers (high BSMJ) but lack confidence in math are especially vulnerable to developing anxiety symptoms when facing math-related tasks. Math-related occupational goals may thus serve as a double-edged sword: they can either motivate achievement or exacerbate anxiety, depending on students' academic self-concept (Lauermann et al., 2017; Christy & Mythili, 2020; Kyttälä & Björn, 2010). For instance, research by Lauermann, Tsai & Eccles (2017) found that adolescents with high math-related career aspirations who also held low math self-efficacy reported elevated stress and disengagement from math activities over time. However, there are also studies suggest that students with high occupational aspirations often perceive math as instrumental to achieving future goals, which can reduce avoidance tendencies and, in some cases, math anxiety , ultimately improving math performance(Luttenberger et al., 2018; Diaconu-Gherasim et al., 2023).

Math anxiety (ANXMAT) has consistently been shown to have a negative effect on math performance among adolescents, making it a significant psychological barrier to achievement in this domain (e.g. Zhou et al., 2020; Ashcraft & Moore, 2009; Hembree, 1990; Foley et al., 2017). Firstly, high levels of math anxiety are associated with lower math grades and reduced engagement with math-related tasks. For instance, Schmitz et al. (2023) found that adolescents with strong associations between math and failure not only reported higher math anxiety but also had significantly lower math grades and exhibited more avoidance behaviors toward math tasks. Secondly, neurocognitive mechanisms also play a role. Thirdly, working memory and self-concept have been shown to mediate the relationship between math anxiety and performance (Ashcraft & Moore, 2009). According to attentional control theory (Eysenck et al., 2007; Eysenck & Derakshan, 2011), anxiety consumes limited working memory resources, thereby reducing the cognitive capacity available for the demanding task of mathematical problem-solving (Ashcraft & Kirk, 2001). Justicia-Galiano et al. (2017) demonstrated that students with higher math anxiety often exhibit reduced working memory capacity and lower math self-concept, both of which contribute to poorer performance. Luttenberger et al. (2018) emphasized that this pattern holds globally and has significant implications for education systems aiming to improve STEM outcomes.

1.3. Societal level differences

The relationship between students' expected occupational status, math anxiety and math performance is not uniform across countries—it is moderated by cultural value systems. One of the most influential cultural dimensions in this context is the flexibility-monumentalism axis introduced by Minkov et al., (2018a). The flexibility-monumentalism dimension, derived from the revised Minkov-Hofstede cultural model, captures societal preferences for adaptability versus rigid adherence to traditions and status hierarchies (Minkov et al., 2018a; Minkov et al., 2018b; Minkov & Kaasa, 2022). And it also captures the extent to which a

culture emphasizes adaptability, humility, and self-improvement (flexibility) versus pride, tradition, and the preservation of self-image (monumentalism; Minkov & Kaasa, 2022). Similarly, Minkov (2008) found that monumentalism is linked with self-beliefs but can hinder optimal academic functioning. Countries scoring higher in flexibility consistently outperform those with higher monumentalism scores in international assessments such as PISA and TIMSS (Minkov & Kaasa, 2021). Thus, The moderating role of FM is especially relevant when analyzing the effects of BSMJ on students' math anxiety and math outcomes.

1.3.1 Culture, BSMJ, and math performance

Research shows that flexibility cultures are associated with higher national educational achievement, particularly in math and science. For example, data from 54 countries indicated that flexibility predicts academic success more strongly than other cultural dimensions, including the original LTO (Minkov et al., 2018a). This cultural orientation may influence BSMJ by promoting future-oriented academic beliefs and encouraging students to value effort and long-term rewards (Minkov et al., 2018a). Furthermore, national differences in flexibility-monumentalism also predict the prevalence of future-oriented cognitive styles, which are central to forming high BSMJ beliefs. For instance, cross-cultural research has shown that future time orientation—a concept closely tied to flexibility—varies by culture and influences how adolescents estimate the probability of future academic and occupational success (Lee et al., 2017). Importantly, cultures high in monumentalism may inhibit BSMJ by reinforcing fixed traits and inherited social status, which may diminish beliefs in individual agency and effort in academic domains. This, in turn, could reduce motivation to engage with challenging subjects like math (Seginer & Halabi, 1991).

1.3.2 Culture, BSMJ and ANXMAT

The interaction between individual future orientation and math anxiety is embedded within the broader cultural context, particularly societal flexibility versus monumentalism. Flexibility as a cultural orientation—emphasizing adaptability, openness to change, and self-improvement—may shape how adolescents internalize academic expectations and manage stress, such as math anxiety (Zheng et al., 2024). Students in societies with greater cultural flexibility may experience reduced performance pressure and emotional rigidity, which can mitigate the internalization of fear related to math, thereby lowering math anxiety levels (Hauser et al., 2015). Conversely, monumentalism—characterized by reverence for tradition, moral rigidity, and the idealization of the past—may inhibit adaptive coping and contribute to increased math anxiety, especially among students who deviate from perceived societal norms (Ang et al., 2009; Kyttälä & Björn, 2010). Cultural flexibility has also been shown to interact with adolescents' math identity development and goal orientation. Cultural support for flexible cognitive styles can protect against the internalization of failure-related beliefs that often exacerbate math anxiety (Cipora et al., 2015). In cultures that support future-oriented thinking and flexible educational trajectories, students may develop more positive expectations and fewer maladaptive emotional responses such as math anxiety (Carey et al., 2023).

1.3.3 Culture, ANXMAT and math performance

A comparative study by Engelhard (1990) across the U.S. and Thailand revealed that although math anxiety predicted lower math scores in both countries, the strength of the effect differed by cultural context, suggesting that societal values (e.g., deference to authority, tolerance of failure) influence how anxiety translates into outcomes. Societies high in flexibility tend to emphasize adaptability, self-improvement, and emotional openness, which can reduce the stigmatization of academic failure and enhance students' emotional regulation in stressful subjects like math (Zheng et al., 2024). In contrast, cultures characterized by monumentalism—where self-stability, honor, and tradition are emphasized—may amplify students' fear of academic failure and reduce their willingness to express or cope with negative emotions, thereby increasing math anxiety and suppressing performance outcomes (Minkov et al., 2018a). Monumentalist cultures may stigmatize underachievement or emotional disclosure, indirectly reinforcing perfectionist ideals that exacerbate math-related anxiety (Matthews, 2018; Schmitz et al., 2023). Empirical research confirms that math anxiety is negatively correlated with math performance, and this relationship is moderated by cultural context. For example, in more flexible societies, the negative impact of math anxiety on achievement is attenuated, possibly due to more adaptive instructional practices and greater acceptance of academic struggle as part of learning (Mejía-Rodríguez & Kyriakides, 2023). These cultural climates may foster self-efficacy and resilience, buffering the adverse effects of anxiety on performance.

1.4. This study

This study aims to explore the mediating role of math anxiety in the relationship between BSMJ and math performance. While prior work has separately linked future occupational expectations to anxiety (Ahmed, 2018), and academic anxiety to performance (Zhou et al., 2020), few studies have tested these variables within a single integrated model. Moreover, there is growing evidence that cultural context influences both future expectations and math-related emotional responses (Ang et al., 2009; Stoet & Geary, 2022). Therefore, this study adopts a multilevel and cross-cultural perspective to examine how societal and cultural factors may moderate the hypothesized mediation pathways between BSMJ, ANXMAT, and math performance.

Based on extant literature we proposed the following hypotheses: BSMJ (X) among adolescents enhances math performance (Y; H1a), and decrease ANXMAT (M; H1b). ANXMAT (M) mediates the association between BSMJ (X) and math performance (Y; H2). FM (W) has a moderating effect on the first stage of the mediating effect of X→M→Y. Specifically, in flexibility (vs. monumentalism) cultures, adolescents' BSMJ is more likely to decrease ANXMAT (H3a). FM (W) has a moderating effect on the second stage of the mediating effect of X→M→Y. Specifically, in flexibility (vs. monumentalism) cultures, ANXMAT lead to a lower math performance (H3b). FM (W) has a moderating effect on the direct effect of X on Y. Specifically, in flexibility (vs. monumentalism) cultures, adolescents' BSMJ can more strongly enhance their math performance (H3c).

The conceptual framework of the hypothetical multi-level structural equation model (MSEM) is shown in Figure 1. The model is a random intercept-random slope model. The first level variables are BSMJ, ANXMAT, and math performance, and the second level variable is FM and GDP.

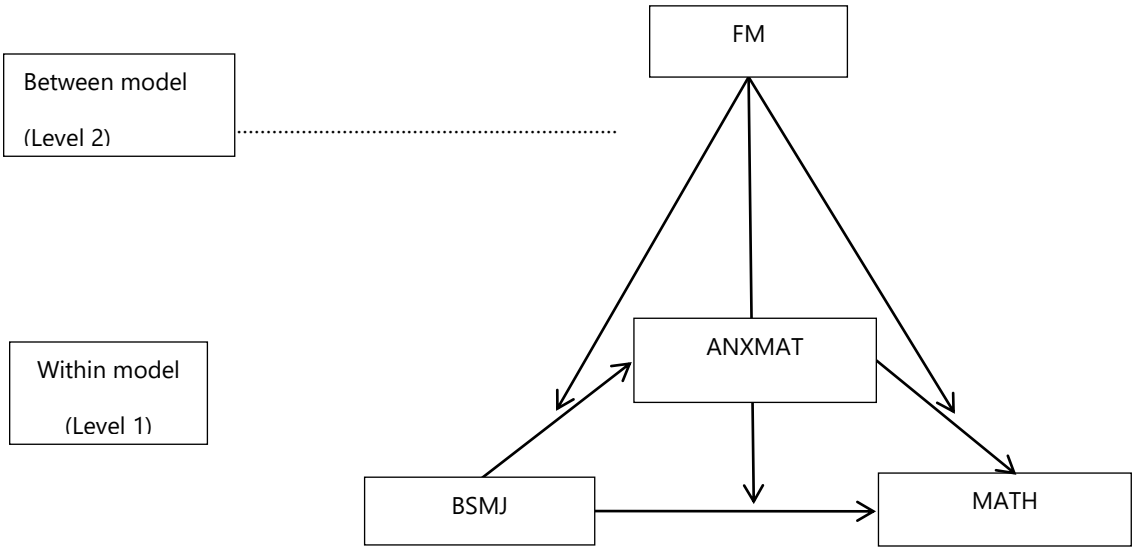

Figure 1. Relationships among research variables

2. Method

2.1. Data and participants

Data for this study was obtained from the 2022 PISA survey (OECD, 2023). 199, 018 15-year-old adolescents (Mage = 15.79 years, SD = 0.29) from 53 countries were retained in our dataset, including 106,282 girls (53.4%) and 92,736 boys (46.6%).

2.2. Individual-level variables

BSMJ. Students' responses about what kind of job they expect to have when they are about 30 years old were human-coded based the ISCO-08 classification system, resulting in the index "Expected Occupation (OCOD3)". These ISCO codes were then mapped to the international socioeconomic index of occupational status (ISEI) in variable BSMJ.

Math anxiety (ANXMAT) . Students' ratings of their agreement with statements about a range of attitudes towards math (e.g., "I often worry that it will be difficult for me in math classes.", "I feel anxious about failing in math.") were scaled into the index of "math anxiety". Each of the six items included in this scale had four response options ("Strongly agree", "Agree", "Disagree", "Strongly disagree"). The Cronbach's α for these items was 0.854.

Math performance. Math performance is indicated by the plausible value of math. Higher scores indicate better math performance.

Age and gender (1 = female, 2 = male) were used as individual-level covariates.

2.3. Country-level variables

Flexibility-monumentalism (FM). The flexibility-monumentalism score of each country/society was taken from the Minkov-Hofstede model (Minkov & Kaasa, 2022). Higher scores indicated stronger societal flexibility.

GDP. The 2022 GDP per capita for each country, obtained from the World Bank, serving as a core indicator of economic development, was used as the country-level covariate.

3. Results

The correlations between key variables see Table 1. Before the analysis, we ran an empty model, yielding an intraclass correlation coefficient of 0.283, which means multilevel linear analysis can be performed.

	BSMJ	Age	Gender	ANXMAT	MATH
BSMJ	1	.010**	-.175**	-.024**	.176**
Age	.010**	1	-.003	.013**	.021**
Gender	-.175**	-.003	1	-.161**	.088**
ANXMAT	-.024**	.013**	-.161**	1	-.257**
MATH	.176**	.021**	.088**	-.257**	1

Note. * = p< 0.05, ** = p< 0.01; BSMJ = Expected occupation status; ANXMAT = Math anxiety; MATH = math performance;

In MSEM model we first analyzed the moderating effect of FM at the first stage of the X→M→Y pathway, namely the effect of M on X (Table 1). Here BSMJ (X), ANXMAT (M), and math performance (Y) are level-1 variables. FM (W) is a moderator at level-2. The results show: (1) at level-1, BSMJ, Age and Gender all have significant positive effects on math performance; ANXMAT has significant negative effect on math performance. (2) Gender has significant negative effect on ANXMAT. (3) the moderating effect of FM is significant, indicating that in flexibility (vs. monumentalism) cultures, adolescents' BSMJ (X) is more likely to decrease ANXMAT (M). (4) FM has a significant negative effect on ANXMAT and significant positive effect on math performance. (5) GDP has a significant effect on ANXMAT and math performance.

Table 1 Moderation effect of FM in the path X→M in MSEM

	Estimate	S.E.	Est./S.E.	Two-tailed p
Within-group effects (level -1)				
MATH on				
ANXMAT	-16.851	0.647	-26.052	0.000
BSMJ	1.234	0.071	17.474	0.000
Age	10.525	1.048	10.041	0.000
Gender	16.077	1.009	15.931	0.000
ANXMAT on				
Age	0.000	0.011	0.018	0.986
Gender	-0.402	0.023	-17.469	0.000
Residual Variances				
ANXMAT	1.241	0.026	47.092	0.000
MATH	6275.558	186.846	33.587	0.000
Between-group effects (level -2)				
S on				
FM	-0.001	0.000	-2.388	0.017
ANXMAT on				
FM	-0.116	0.033	-3.546	0.000
logGDP	0.001	0.000	4.586	0.000
MATH on				
FM	43.082	4.298	10.023	0.000
LogGDP	0.049	0.020	2.485	0.013
Residual Variances				
ANXMAT	0.031	0.006	5.450	0.000
MATH	973.017	217.096	4.482	0.000
S	0.000	0.000	4.210	0.000

Note. Estimate = Standardized coefficient (β); BSMJ = Expected occupation status; ANXMAT = Math anxiety; MATH = math performance; FM = flexibility-monumentalism; GDP = GDP per capita; two-tailed p value.

Second, we analyzed the moderating effect of FM in the second stage of the X→M→Y pathway (Table 2). Here BSMJ (X), ANXMAT (M), and math performance (Y) are level-1 variables, and FM(W) is a moderator at level-2. The results show: (1) at level-1, BSMJ and Gender all have significant negative effects on ANXMAT; BSMJ, Age and Gender has significant positive effect on math performance. (2) Gender has significant negative effect on ANXMAT. (3) the moderating effect of FM is significant, indicating that in flexibility (vs. monumentalism) cultures, adolescents' ANXMAT (X) is more likely to decrease math performance(M). (4) FM and GDP has a significant positive effect on math performance.

Table 2 Moderation effect of FM in the path M→Y in MSEM

	Estimate	S.E.	Est./S.E.	Two-tailed p
Within-group effects (level -1)				
ANXMAT on				
BSMJ	-0.004	0.000	-12.682	0.000
Gender	-0.403	0.023	-17.523	0.000
Age	0.000	0.012	-0.020	0.984
MATH on				
BSMJ	1.227	0.071	17.372	0.000
Gender	15.683	1.015	15.453	0.000
Age	10.531	1.044	10.086	0.000
Residual Variances				
ANXMAT	1.242	0.026	47.084	0.000
MATH	6249.628	187.947	33.252	0.000
Between-group effects (level -2)				
S on				
FM	-2.975	0.534	-5.567	0.000
MATH on				
FM	41.956	4.423	9.485	0.000
logGDP	0.064	0.018	3.621	0.000
Residual Variances				
MATH	990.894	227.369	4.358	0.000
S	15.191	3.052	4.978	0.000

Note. Estimate = Standardized coefficient (β); BSMJ = Expected occupation status; ANXMAT = Math anxiety; MATH = math performance; FM = flexibility-monumentalism; GDP = GDP per capita; two-tailed p value.

Third, we examine whether FM moderate the direct effect (namely Y on X) in our MSEM model (Table 3). Here BSMJ (X), ANXMAT (M), and math performance (Y) are level-1 variables, and FM (W) is a moderator at level-2. The results show: (1) at level-1, ANXMAT has significant negative effects on math performance; Age and Gender has significant positive effect on math performance. (2) Gender has significant negative effect on ANXMAT. (3) the moderating effect of FM is significant, indicating that in flexibility (vs. monumentalism) cultures, adolescents' BSMJ (X) is more likely to increase math performance(M). (4) FM and GDP has a significant positive effect on math performance.

Table 3. Moderation effect of FM in the path X→Y in MSEM

	Estimate	S.E.	Est./S.E.	Two-tailed p
Within-group effects (level -1)				
MATH on				
ANXMAT (S)	-16.781	0.650	-25.834	0.000
Gender	15.959	1.026	15.560	0.000
Age	10.376	1.034	10.037	0.000
ANXMAT on				
Gender	-0.373	0.022	-16.987	0.000
Age	-0.001	0.011	-0.073	0.942
Residual Variances				
ANXMAT	1.248	0.027	46.812	0.000
MATH	6208.833	187.315	33.147	0.000
Between-group effects (level -2)				
S on				
FM	0.243	0.053	4.574	0.000
MATH on				
FM	41.784	4.372	9.557	0.000
logGDP	0.120	0.019	6.185	0.000
Residual Variances				
MATH	989.096	218.891	4.519	0.000
S	0.136	0.027	5.051	0.000

Note. Estimate = Standardized coefficient (β); BSMJ = Expected occupation status; ANXMAT = Math anxiety; MATH = math performance; FM = flexibility-monumentalism; GDP = GDP per capita; two-tailed p value.

4. Discussion

The present study aimed to examine the mediating role of math anxiety (ANXMAT) in the relationship between expected occupation (BSMJ) and math performance among adolescents across a larger-scale and nationally representative sample, as well as how these associations are moderated by national-level cultural (flexibility–monumentalism) contexts. The multilevel analysis revealed several notable findings that align with, and extend, existing psychological and cross-cultural theories.

This study Consistent with our hypotheses (H1a, H1b, H2), three key relationships emerged: (1) BSMJ positively predicts math performance, (2) BSMJ negatively predicts ANXMAT, (3) ANXMAT negatively predicts math performance, (4)ANXMAT mediates the association between BSMJ and math performance. As previous studies have shown, adolescents who anticipate future careers involving math tend to perform better academically due to heightened motivation and long-term goal setting (Lauermann et al., 2017; Wang & Degol, 2013). These findings align with expectancy–value theory, which posits that students' beliefs about their abilities and future success influence academic achievement (Lauermann et al., 2017). Adolescents who hold a strong belief in their capacity to control outcomes tend to report lower levels of anxiety in math contexts. Future orientation, particularly confidence in one's career or academic trajectory, has been associated with reduced anxiety and depression in

adolescents (Lee, 2022). Moreover, career decidedness and self-determined goals can buffer against math-related anxiety, as students perceive a clearer connection between present efforts and future success (McCormick & Jung, 2011). Thus, adolescents with strong BSMJ may experience less anxiety due to a more coherent and motivated academic identity. There is robust evidence showing that math anxiety significantly impairs performance. Anxiety interferes with working memory and cognitive processing, which are critical for solving mathematical problems (Kyttälä & Björn, 2010). High levels of ANXMAT have been linked to avoidance of challenging tasks, lower confidence, and ultimately lower achievement (Mews & Pöge, 2019). Importantly, even students with strong math skills may underperform when anxiety is high, highlighting the broad impact of emotional factors on cognitive outcomes (Kyttälä & Björn, 2010). Together, these findings suggest that adolescents who believe in their ability to shape their BSMJ are less likely to experience debilitating math anxiety, which in turn facilitates better performance in math. Math anxiety thus functions as a key emotional mechanism mediating the influence of BSMJ on math performance.

Consistent with hypothesis 3a, in flexibility (vs. monumentalism) cultures, adolescents' BSMJ is more likely to decrease math anxiety. In flexible societies, adolescents are more likely to internalize cultural norms that promote change, self-direction, and emotional adaptability, which may facilitate the translation of broad-scope job motivation into reduced math anxiety, including math anxiety. Cultural flexibility has been linked to greater cognitive adaptability and coping skills, both of which are protective against anxiety (Minkov et al., 2018a; Minkov & Kaasa, 2022; Wei et al., 2019; Cheng et al., 2014). Adolescents in such contexts may perceive educational aspirations as achievable and under their control, reducing the anxiety associated with academic evaluations (Seginer, 2019). On the other hand, in monumentalism-oriented cultures where identity and expectations are rigid and highly normative, the pressure to succeed in line with socially prescribed futures can increase anxiety (Minkov et al., 2018a). Adolescents with strong BSMJ in these cultures may face conflicting demands between personal aspirations and collective ideals, heightening stress and negative affect (Seginer & Halabi, 1991). Consequently, the protective effect of BSMJ on ANXMAT may be dampened or even reversed in these cultural contexts.

Consistent with hypothesis 3b, in flexibility (vs. monumentalism) cultures, ANXMAT lead to a lower math performance. A growing body of cross-cultural research suggests that the cultural dimension of flexibility versus monumentalism plays a moderating role in the relationship between math anxiety (ANXMAT) and math performance. Specifically, in cultures high in flexibility—those emphasizing adaptability, humility, and self-improvement—students may be better equipped to manage math-related anxiety and maintain stronger math outcomes. Math anxiety has been consistently found to negatively predict math performance, often by interfering with working memory and cognitive efficiency (Zhang et al., 2019; Skaalvik, 2018). The link is especially strong in high-performing or high-anxiety contexts, which can exacerbate self-doubt and lead to performance decrements even in students with high mathematical aptitude (Weissgerber et al., 2022). Flexibility as a cultural trait may mitigate this negative impact by fostering adaptive coping strategies, a growth mindset, and openness to self-regulation, all of which reduce the psychological burden of failure and performance pressure (Zheng et al., 2024). For example, in societies with higher flexibility, adolescents tend to exhibit greater cognitive and emotional resilience, which correlates with lower math anxiety and better math outcomes (Güner & Gökçe, 2021). Recent cross-national findings support this interaction: the detrimental effects of math anxiety on performance were more pronounced in cultures lower in societal flexibility, where personal failure is less tolerated and identity is tied more closely to social roles and success (Mejía-Rodríguez & Kyriakides, 2023). Conversely, in more flexible societies, students may be more likely to interpret setbacks as opportunities for growth rather than as fixed indicators of personal inadequacy (Cipora et al., 2015).

Consistent with hypothesis 3c, our findings reveal that national culture, particularly the dimension of flexibility-monumentalism , moderates the relationship between adolescents' BSMJ and math performance. Specifically, in flexibility-oriented cultures, the positive effect of BSMJ on math performance is more pronounced. Flexibility-monumentalism reflects differences in cultural values such as adaptability, humility, and openness to change (Minkov et al., 2018a). Evidence shows that cognitive flexibility is strongly linked to academic achievement across countries, and this relationship is stronger in more flexibility-oriented societies (Zheng et al., 2024). Additionally, flexible societies tend to promote future-oriented cognition through enhanced executive functions like inhibition and perspective-shifting, which further mediate the relationship between motivational beliefs and academic outcomes (Ding et al., 2023). On the other hand, in monumentalism-oriented cultures—which promote strong identity, pride, and consistency—students may feel social pressure to conform and preserve established self-views rather than adapt flexibly to goals like BSMJ. Consequently, they may be less likely to translate such beliefs into performance gains (Minkov & Kaasa, 2022). Thus, the culture of flexibility amplifies the benefits of future-oriented occupational beliefs like BSMJ on math performance by fostering a climate that values adaptability, personal growth, and academic striving.

5. Limitations and Future Directions

Although this study contributes to our understanding of how adolescents' excepted occupation status interacts with math anxiety and math performance across cultures, several limitations warrant caution and open avenues for future inquiry. First, the cross-sectional design of the PISA dataset prohibits causal inference between BSMJ, ANXMAT, and math achievement.

Longitudinal data are necessary to establish the temporal ordering of predictors and outcomes (Kyttälä & Björn, 2010). Second, the measurement of BSMJ was indirectly inferred from related constructs such as future orientation and expected occupation. While theoretically justifiable, this may compromise construct validity. Developing and validating a culturally generalizable scale for BSMJ is necessary (Seginer, 2019). Third, although our findings support a mediating role of math anxiety, future research should incorporate additional cognitive-emotional variables such as self-efficacy and intrinsic motivation (Matthews, 2018). Fourth, cultural dimensions are inherently complex and may interact with one another (Minkov et al., 2018a). Finally, reliance on self-reported math anxiety limits the scope of emotional insight. Future research could include real-time physiological indicators or behavioral markers to strengthen measurement robustness (Carey et al., 2023).

6. Conclusion

This study contributes to the growing body of literature on adolescents' future-oriented motivation by highlighting how expected occupation status predicts math outcomes and math anxiety in cross-cultural contexts. Our findings suggest that BSMJ is a significant positive predictor of adolescents' math performance. Math anxiety plays a mediating role in this process. Adolescents' broad-scope future motivation predicts better math achievement through decreased math anxiety, especially in cultures that support flexibility, supporting cross-cultural psychology frameworks that emphasize the interaction between personal motivations and cultural norms (Bond et al., 2004; Gelfand et al., 2011). Educational systems should prioritize career-linked motivation and emotional support strategies to improve academic outcomes globally.

Data availability statement: The data used in this study were obtained from publicly available databases and had no ethical implications. The data that support the findings of this study are available in [PISA 2022 Database] at https://www.oecd.org/en/data/datasets/pisa-2022-database.html

Funding statement: There is no funding.

Conflict of interest disclosure: There is no conflict of interest.

Ethics approval: This is an observational study. The Guangxi Normal University Research Ethics Committee has confirmed that no ethical approval is required.

Patient consent statement: This is an observational study. The data is publicly available and does not require informed consent.

References

[1] Ahmed, W. (2018). Developmental trajectories of math anxiety during adolescence: Associations with STEM career choice. *Journal of adolescence*, 67, 158-166. https://doi.org/10.1016/j.adolescence.2018.06.010

[2] Ang, R. P., Klassen, R. M., Chong, W. H., Huan, V. S., Wong, I. Y., Yeo, L. S., & Krawchuk, L. L. (2009). Cross-cultural invariance of the academic expectations stress inventory: Adolescent samples from Canada and Singapore. *Journal of adolescence*, 32(5), 1225-1237. https://doi.org/10.1016/j.adolescence.2009.01.009

[3] Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. Psychonomic bulletin & review, 14(2), 243-248. https://doi.org/10.3758/bf03194059

[4] Ashcraft, M. H., & Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. *Journal of Psychoeducational assessment*, 27(3), 197-205. https://doi.org/10.1177/0734282908330580

[5] Bond, M. H., Leung, K., Au, A., Tong, K. K., De Carrasquel, S. R., Murakami, F., ... & Lewis, J. R. (2004). Culture-level dimensions of social axioms and their correlates across 41 cultures. *Journal of cross-cultural psychology,* 35(5), 548-570. https://doi.org/10.1177/0022022104268388

[6] Bowles, T. (2008). The relationship of time orientation with perceived academic performance and preparation for assessment in adolescents. Educational Psychology, 28(5), 551-565. https://doi.org/10.1080/01443410701880134

[7] Carey, R. L., Bailey, M. J., & Polanco, C. I. (2023). How the COVID-19 pandemic shaped adolescents' future orientations: Insights from a global scoping review. Current opinion in psychology, 53, 101655. https://doi.org/10.1016/j.copsyc.2023.101655

[8] Cheng, C., Lau, H. P. B., & Chan, M. P. S. (2014). Coping flexibility and psychological adjustment to stressful life changes: a meta-analytic review. Psychological bulletin, 140(6), 1582.

[9] Christy, X. I., & Mythili, T. (2020). Self-esteem, self-efficacy and academic performance among adolescents. *Journal of Indian Association for Child and Adolescent Mental Health*, 16(2), 123-135. https://doi.org/10.1177/0973134220200209

[10] Cipora, K., Szczygieł, M., Willmes, K., & Nuerk, H. C. (2015). Math anxiety assessment with the Abbreviated Math Anxiety Scale: Applicability and usefulness: Insights from the Polish adaptation. Frontiers in psychology, 6, 1833. https://doi.org/10.3389/fpsyg.2015.01833

[11] Diaconu-Gherasim, L. R., Brumariu, L. E., Moore, M. T., & Kerns, K. A. (2023). School and career future time perspective and academic-related outcomes in early adolescence: are mastery goals mediators?. Educational Psychology, 43(2-3), 119-136. https://doi.org/10.1080/01443410.2022.2136361

[12] Ding, N., Miller, R., & Clayton, N. S. (2023). Inhibition and cognitive flexibility are related to prediction of one's own future preferences in young British and Chinese children. Cognition, 236, 105433. https://doi.org/10.1016/j.cognition.2023.105433

[13] Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. Annual review of psychology, 53(1), 109-132. https://doi.org/10.1146/annurev.psych.53.100901.135153

[14] Engelhard, G. (1990). Math anxiety, mother's education, and the mathematics performance of adolescent boys and girls: Evidence from the United States and Thailand. *The Journal of psychology*, 124(3), 289-298. https://doi.org/10.1080/00223980.1990.10543224

[15] Eysenck, M. W., & Derakshan, N. (2011). New perspectives in attentional control theory. Personality and Individual Differences, 50(7), 955-960. https://doi.org/10.1016/j.paid.2010.08.019

[16] Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. Emotion, 7(2), 336.
[17] Foley, A. E., Herts, J. B., Borgonovi, F., Guerriero, S., Levine, S. C., & Beilock, S. L. (2017). The math anxiety-performance link: A global phenomenon. Current directions in psychological science, 26(1), 52-58. https://doi.org/10.1177/0963721416672463
[18] Gelfand, M. J., Raver, J. L., Nishii, L., Leslie, L. M., Lun, J., Lim, B. C., ... & Yamaguchi, S. (2011). Differences between tight and loose cultures: A 33-nation study. science, 332(6033), 1100-1104. https://doi.org/10.1126/science.1197754
[19] Guglielmi, R. S., & Brekke, N. (2018). A latent growth moderated mediation model of math achievement and postsecondary attainment: Focusing on context-invariant predictors. *Journal of Educational Psychology,* 110(5), 683. https://doi.org/10.1037/edu0000238
[20] Güner, P., & Gökçe, S. (2021). Linking critical thinking disposition, cognitive flexibility and achievement: Math anxiety's mediating role. *The Journal of Educational Research*, 114(5), 458-473. https://doi.org/10.1080/00220671.2021.1975618
[21] Hauser, T. U., Iannaccone, R., Walitza, S., Brandeis, D., & Brem, S. (2015). Cognitive flexibility in adolescence: Neural and behavioral mechanisms of reward prediction error processing in adaptive decision making during development. NeuroImage, 104, 347-354. https://doi.org/10.1016/j.neuroimage.2014.09.018
[22] Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for research in mathematics education, 21*(1), 33-46. https://doi.org/10.5951/jresematheduc.21.1.0033
[23] Justicia-Galiano, M. J., Martín-Puga, M. E., Linares, R., & Pelegrina, S. (2017). Math anxiety and math performance in children: The mediating roles of working memory and math self-concept. *British Journal of Educational Psychology, 87*(4), 573-589. https://doi.org/10.1111/bjep.12165
[24] Kyttälä, M., & Björn, P. M. (2010). Prior mathematics achievement, cognitive appraisals and anxiety as predictors of Finnish students' later mathematics performance and career orientation. Educational Psychology, 30(4), 431-448. https://doi.org/10.1080/01443411003724491
[25] Lauermann, F., Tsai, Y. M., & Eccles, J. S. (2017). Math-related career aspirations and choices within Eccles et al.'s expectancy–value theory of achievement-related behaviors. Developmental psychology, 53(8), 1540.
[26] Lee, R. (2022). Future Orientation's Influence on Smartphone Overdependence among Out-of-School Adolescents: Focusing on the Moderated Mediation Effect of Depression by Parental Emotional Support. STRESS. https://doi.org/10.17547/kjsr.2022.30.4.213 .
[27] Lee, S., Liu, M., & Hu, M. (2017). Relationship between future time orientation and item nonresponse on subjective probability questions: A cross-cultural analysis. *Journal of cross-cultural psychology,* 48(5), 698-717. https://doi.org/10.1177/0022022117698572
[28] Luttenberger, S., Wimmer, S., & Paechter, M. (2018). Spotlight on math anxiety. Psychology research and behavior management, 311-322. https://doi.org/10.1177/0022022117698572
[29] Matthews, J. S. (2018). When am I ever going to use this in the real world? Cognitive flexibility and urban adolescents' negotiation of the value of mathematics. *Journal of Educational Psychology,* 110(5), 726.
[30] McCormick, J. M., & Jung, J. Y. (2011). Occupational decision-related processes for amotivated adolescents: confirmation of a model. https://doi.org/10.1177/0894845310367638
[31] Mejia-Rodriguez, A. M., & Kyriakides, L. (2023). Searching for the impact of national culture dimensions on student achievement: implications for educational effectiveness research. School Effectiveness and School Improvement, 34(2), 226-246. https://doi.org/10.1080/09243453.2023.2171068
[32] Mews, S., & Pöge, A. (2019). Das Zusammenspiel von Selbstbildern, motivationalen und emotionalen Orientierungen sowie deren Einfluss auf die Mathematikleistung in der PISA-Studie 2012. Zeitschrift für Erziehungswissenschaft, 22(4), 899-924. https://doi.org/10.1007/s11618-019-00898-w
[33] Minkov, M. (2008). Self-enhancement and self-stability predict school achievement at the national level, Cross-Cultural Research: *The Journal of Comparative Social Science*, 42, 172–196. https://doi.org/10.1177/ 1069397107312956
[34] Minkov, M., & Kaasa, A. (2021). A test of the revised Minkov-Hofstede model of culture: Mirror images of subjective and objective culture across nations and the 50 US states. Cross-Cultural Research, 55(2-3), 230-281. https://doi.org/10.1177/10693971211014468
[35] Minkov, M., & Kaasa, A. (2022). Do dimensions of culture exist objectively? A validation of the revised Minkov-Hofstede model of culture with World Values Survey items and scores for 102 countries. *Journal of International Management,* 28(4), 100971. https://doi.org/10.1016/j.intman.2022.100971
[36] Minkov, M., Bond, M. H., Dutt, P., Schachner, M., Morales, O., Sanchez, C., ... & Mudd, B. (2018). A reconsideration of Hofstede's fifth dimension: New flexibility versus monumentalism data from 54 countries. Cross-Cultural Research, 52(3), 309-333. https://doi.org/10.1177/1069397117727488
[37] Minkov, M., Dutt, P., Schachner, M., Jandosova, J., Khassenbekov, Y., Morales, O., ... & Mudd, B. (2018). What values and traits do parents teach to their children? New data from 54 countries. Comparative Sociology, 17(2), 221-252. https://doi.org/10.1163/15691330-12341456
[38] Nurmi, J. E. (1989). Development of orientation to the future during early adolescence: a four-year longitudinal study and two cross-sectional comparisons. *International Journal of Psychology*, 24(1-5), 195-214. https://doi.org/10.1080/00207594.1989.10600042
[39] Nurmi, J. E. (1991). How do adolescents see their future? A review of the development of future orientation and planning. Developmental review, 11(1), 1-59. https://doi.org/10.1016/0273-2297(91)90002-6
[40] OECD. (2019). PISA 2018 Results (Volume II): Where All Students Can Succeed. OECD Publishing.
[41] Pawlak, S., & Moustafa, A. A. (2023). A systematic review of the impact of future-oriented thinking on academic outcomes. Frontiers in psychology, 14, 1190546. https://doi.org/10.3389/fpsyg.2023.1190546
[42] Schmitz, E. A., Jansen, B. R., Wiers, R. W., & Salemink, E. (2023). Math-failure associations, attentional biases, and avoidance bias: The relationship with math anxiety and behaviour in adolescents. Cognitive Therapy and Research, 47(5), 788-801. https://doi.org/10.1007/s10608-023-10390-9
[43] Seginer, R. (2019). Adolescent future orientation: Does culture matter?. Online readings in Psychology and Culture, 6(1), 5. https://doi.org/10.9707/2307-0919.1056
[44] Seginer, R., & Shoyer, S. (2012). How mothers affect adolescents' future orientation: A two-source analysis. Japanese Psychological Research, 54(3), 310-320. https://doi.org/10.1111/j.1468-5884.2012.00522.x

[45] Selkirk, L. C., Bouchey, H. A., & Eccles, J. S. (2011). Interactions among domain-specific expectancies, values, and gender: Predictors of test anxiety during early adolescence. *The Journal of Early Adolescence,* 31(3), 361-389. https://doi.org/10.1177/0272431610363156

[46] Semeraro, C., Giofrè, D., Coppola, G., Lucangeli, D., & Cassibba, R. (2020). The role of cognitive and non-cognitive factors in mathematics achievement: The importance of the quality of the student-teacher relationship in middle school. Plos one, 15(4), e0231381. https://doi.org/10.1371/journal.pone.0231381

[47] Skaalvik, E. M. (2018). Mathematics anxiety and coping strategies among middle school students: relations with students' achievement goal orientations and level of performance. Social Psychology of Education, 21(3), 709-723. https://doi.org/10.1007/s11218-018-9433-2

[48] Stoet, G., & Geary, D. C. (2022). Sex differences in adolescents' occupational aspirations: Variations across time and place. Plos one, 17(1), e0261438. https://doi.org/10.1371/journal.pone.0261438

[49] Trommsdorff, G., Lamm, H., & Schmidt, R. W. (1979). A longitudinal study of adolescents' future orientation (time perspective). *Journal of youth and adolescence*, 8(2), 131-147. https://doi.org/10.1007/bf02087616

[50] Wang, M. T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. Developmental review, 33(4), 304-340. https://doi.org/10.1016/j.dr.2013.08.001

[51] Wang, Y., & Wang, Y. (2023). Exploring the relationship between educational ICT resources, student engagement, and academic performance: a multilevel structural equation analysis based on PISA 2018 data. Studies in Educational Evaluation, 79, 101308. https://doi.org/10.1016/j.stueduc.2023.101308.

[52] Wei, M., Wang, C., Ko, S. Y., Liu, S., & Botello, R. (2019). Bicultural stress and perceived benefits among Asian Americans: The roles of cognitive flexibility and making positive sense of adversity. *Asian American Journal of Psychology*, 10(4), 351. https://doi.org/10.1037/aap0000158

[53] Weissgerber, S. C., Grünberg, C., Neufeld, L., Steppat, T., & Reinhard, M. A. (2022). The interplay of math anxiety and math competence for later performance. Social Psychology of Education, 25(4), 977-1002. https://doi.org/10.1007/s11218-022-09700-y

[54] Zhang, J., Zhao, N., & Kong, Q. P. (2019). The relationship between math anxiety and math performance: A meta-analytic investigation. Frontiers in psychology, 10, 1613. https://doi.org/10.3389/fpsyg.2019.01613

[55] Zheng, W., Akaliyski, P., Ma, C., & Xu, Y. (2024). Cognitive flexibility and academic performance: Individual and cross-national patterns among adolescents in 57 countries. Personality and Individual Differences, 217, 112455. https://doi.org/10.1016/j.paid.2023.112455

[56] Zhou, D., Du, X., Hau, K. T., Luo, H., Feng, P., & Liu, J. (2020). Teacher-student relationship and mathematical problem-solving ability: mediating roles of self-efficacy and mathematical anxiety. Educational Psychology, 40(4), 473-489. https://doi.org/10.1080/01443410.2019.1696947

[57] Zimbardo, P. G., & Boyd, J. N. (2014). Putting time in perspective: A valid, reliable individual-differences metric. In Time perspective theory; review, research and application: Essays in honor of Philip G. Zimbardo (pp. 17-55). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-07368-2_2