Psychometric Properties and Measurement Invariance of the 3×2 Achievement Goals Questionnaire for Exercise (3×2 AGQ-E) among Chinese Mainland adolescents

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Abstract

This study aimed to evaluate the psychometric characteristics of the 3×2 Achievement Goals Questionnaire for Exercise (3×2 AGQ-E) tailored for Chinese mainland adolescents in an exercise context. Participants included adolescents from junior and senior high schools across mainland China. study investigation focused on factorial validity, discriminant validity, internal consistency reliability, and measurement invariance across gender and academic levels of the 3×2 AGQ-E. Confirmatory factor analysis upheld the proposed multi-dimensional structure (CFI = .0.992, TLI = 0.972, RMSEA = 0.042). Inter-factor correlations, examined within a 95% confidence interval, underscored the discriminant validity of the 3×2 AGQ-E, indicating its capability to assess interconnected yet distinct constructs. The instrument demonstrated excellent internal consistency (Cronbach's α>0.80). The nomological validity was supported by a consistent pattern in inter-factor correlations. Multi-group confirmatory factor analysis suggested robust measurement invariance, with consistent factor loadings and variances-covariances across genders (△=0.000 to 0.007) and academic levels (△= 0.001 to 0.014). This research provides crucial psychometric support for the 3×2 AGQ-E, enhancing its utility for future research and application in understanding achievement motivations among Chinese mainland adolescents in the context of exercise and physical activities.

Keywords: 3×2 Achievement Goals, Chinese, Adolescents, Psychometric Characteristics

Introduction

Definition of Achievement Goals

For three decades, Achievement Goals Theory (AGT) has been a central theoretical framework utilized to elucidate the underlying mechanisms of achievement motivation (Barron & Harackiewicz, 2001; Pintrich, 2000). Fundamentally, this theory delves into how individuals perceive, interpret, and construct their sense of self-competence within specific achievement-driven contexts, offering insights into how they delineate their successes and failures (Mascret, Elliot, & Cury, 2015). As with many psychological constructs, the conceptualization of achievement goals has been subject to various interpretations across scholars. Notably, several psychologists delineate achievement goals through myriad lenses: some envision them strictly as objectives, while others perceive them as an amalgamation of objectives and underlying causative factors or even as a more encompassing orientation towards achievement (Ames, 1984, 1992; Dweck, 1986; Nicholls, 1984; Roberts, Treasure, & Balague, 1998). Elliot and Harackiewicz (1996) offer a more complex perspective, positing that achievement goals operate as premeditated cognitive processes characterized by a nexus of cognitive, emotional, and behavioral facets. Expanding on this, Ryan and Shim (2006) propound that these goals encapsulate individuals' perceptions concerning the inherent significance of various domains

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such as learning, academic accomplishments, occupational endeavors, and notions of success. They further conceptualize achievement goals as a holistic model amalgamating success or failure attributions, belief systems regarding one's ability, and associated emotional states. Echoing these sentiments, Pekrun, Elliot, and Maier (2009) and Pintrich (2000) also contend that achievement goals emerge from a synthesis of objectives and causative factors, representing an individual's internal cognitive orientation directed towards achievement tasks. From another vantage point, Elliot and Murayama (2008) conceptualize achievement goals as fluid cognitive targets that underscore the pivotal role of competence in influencing individuals' behaviors and motivations. Diving deeper, Maehr and Midgley (1991) argue for the multidimensionality of achievement goals, suggesting they are intricate constructs interwoven with achievement outcomes, goal-setting mechanisms, and underlying motivational drivers. This perspective is somewhat distinct from others, like Hwang, Machida, and Choi (2017), who emphasize that, within exercise settings, achievement goals transcend other psychological states due to their specific target-oriented focus coupled with evaluation-centric cognitive operations. Therefore, while academic discourses over the years have presented varied definitions of achievement goals, a common thread runs through these interpretations. Most scholars converge on the idea that achievement goals encompass a combination of objectives, motivations, and cognitive evaluations, highlighting their salience in understanding achievement behaviors (Dweck, 1986; Maehr & Midgley, 1991; Nicholls, 1984; Roberts et al., 1998).

Classifications of Achievement Goals

The Dichotomous Achievement Goals Theory draws from social cognitive perspectives to elucidate the underlying factors and mechanisms shaping achievement behaviors within achievement-oriented contexts. Central to this theory is the social cognitive approach that foregrounds the intricate interplay of individual personal factors, such as goal orientation (Nicholls, 1984), and environmental factors, like the motivational climate (Ames, 1992). Notably, the reciprocal interactions between these personal and environmental factors fundamentally shape the manner in which individuals perceive, interpret, and subsequently construct their self-competence within each achievement-driven situation.

This nexus of interactions profoundly impacts goal involvement, which, as posited by Nicholls (1984), determines how people discern or construct their self-competence in specific achievement settings. Further, the degree and nature of goal involvement can substantially

modulate how individuals either strive towards or evade the demonstration of competence. This divergence in goal involvement can manifest in various facets of achievement behaviors, such as perseverance, the choice of tasks, the level of effort expended, and overall performance outcomes (Treasure et al., 2001).

Building upon the foundational concepts of Dichotomous Achievement Goals Theory, Elliot (1999) introduced an enhanced psychological perspective, encompassing both approach and avoidance motivations. He put forth the Trichotomous Achievement Goals Theory, incorporating three primary goal orientations: mastery, performance approach, and performance-avoidance. This nuanced perspective was later expanded by Elliot and McGregor (2001), who distinguished mastery goals further into mastery-approach and mastery-avoidance sub-categories. This bifurcation led to the formulation of the 2 × 2 Achievement Goals Theory, a model that has garnered substantial empirical support in contemporary academic discourse (Elliot & Church, 1997; Elliot & McGregor, 2001). Further advancing the field, Elliot, Murayama, and Pekrun (2011) revisited and refined the conceptualization of competencies. They integrated the original valence-driven motivational characteristics to categorize competency definitions based on three primary criteria: absolute, intrapersonal, and normative. This reconceptualization culminated in the proposal of the 3×2 Achievement Goals Model. The evolutionary trajectory of the achievement goals model can be visualized sequentially, as depicted in Figure 1.
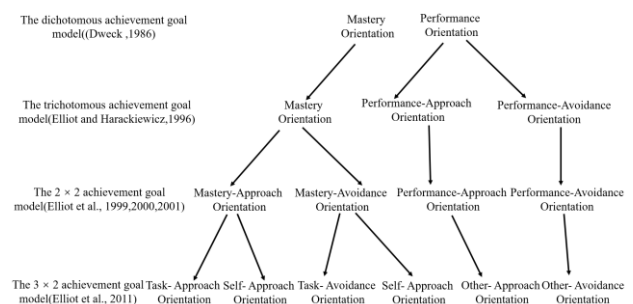
Figure 1. The Development of The Achievement Goals Model.

The measurement of 3×2 achievement goals model

This study's questionnaire is adapted from the 3×2 Achievement Goals Questionnaire (3×2 AGQ) introduced by Elliot et al. (2011) to investigate students' achievement goal orientations. The 3×2 AGQ features 18 items, spanning goal categories like task-approach, task-avoidance, and others, rated on a Likert scale from 1 (Strongly Disagree) to 7 (Strongly Agree). Elliot et al. confirmed its validity, showing a superior fit (CFI=0.98) over other models, such as the dichotomous (CFI=0.77)

and the trichotomous (CFI=0.81) versions. Mascret et al. (2015) later introduced the 3×2 Achievement Goals Questionnaire-Sports (3×2 AGQ-S) for sports contexts. This version maintained robust psychometric attributes (CFI = 0.99, IFI = 0.99, RMSEA = 0.04), with each factor exhibiting consistency (Standardized loadings = 0.70-0.92, Cronbach's alpha = 0.80-0.93). In the context of Chinese cultural environment, Wu (2012) made a detailed study on the applicability of the 3×2achievement goals model among the youth group in Taiwan, China. The research shows that among this group, 3×2 achievement goals model has a better model fit and no significant gender difference. Ning (2018) analyzed The validity of 3×2 achievement goals questionnaire for Hong Kong undergraduates, and the results showed that The six goal subscales have high internal consistency reliability.

However, there is no validation of the Psychometric Properties of the 3×2 Achievement Goals Questionnaire for a group of Chinese mainland adolescents in an exercise context in the existing research. Therefore, during this research, the 3×2 AGQ and AGQ-S served as foundations, but with modifications aligning with the psychological profiles of adolescents. Recognizing that original versions targeted college students, and the nuanced cognitive development of younger respondents, specific terms were revised. This newly devised 3×2 Achievement Goals Questionnaire for Exercise (3×2 AGQ-E), tailored for exercise, consists of 30 items across six dimensions, rated on a 7-point Likert scale. The purpose of this study was to explore the psychometric characteristics of 3×2 AGQ-E among Chinese mainland adolescents.

Therefore, study proposed five research objectives:

(1) to examine the factorial validity of 3×2 AGQ-E among Chinese mainland adolescents.

(2) to examine the discriminant validity of 3×2 AGQ-E among Chinese mainland adolescents.

(3) to examine the internal consistency reliability of 3×2 AGQ-E among Chinese mainland adolescents.

(4) to examine the measurement invariance between different gender and academic level groups.

(5) to examine the measurement invariance between different gender and academic level.

Literature Review

Understanding the multifaceted nature of achievement motivation within educational and physical domains has been a key endeavor in psychological research, with Achievement Goal Theory (AGT) providing a comprehensive framework. AGT, evolving from a dichotomous to a more nuanced trichotomous and finally to the 3×2 model, has significantly contributed to our understanding of how individuals' goals influence their behavior in achievement contexts(Elliot et al., 2011; Sommet & Elliot, 2017). The 3×2 model introduced by Elliot et al. (2011) has been instrumental in advancing the conceptualization of achievement goals. It has been validated across diverse populations, highlighting the importance of task, self, and other-based goals, each with approach and avoidance dimensions (Elliot & McGregor, 2001; Elliot et al., 2011). These dimensions have been found to significantly predict engagement and attainment in educational settings (Senko, Hulleman, & Harackiewicz, 2011).

Research in AGT contexts has begun to explore the validity of achievement goal models, particularly among university students(Kamari et al., 2021; Kumar & Gunawardana, 2014). These studies, while insightful, have often been limited to academic performance, overlooking physical activity—a domain where motivation plays a critical role (Isoard-Gautheur et al., 2016).

The Chinese educational landscape, influenced by Confucian heritage, prioritizes academic excellence and perseverance (An et al., 2021). This cultural backdrop necessitates an examination of the 3×2 model's applicability among Chinese adolescents, particularly in exercise contexts, where motivation can significantly impact students' physical activity engagement (Cho et al., 2019).

Gender differences in goal orientations have been widely noted, with some studies suggesting that male and female students may prioritize different achievement goals (Agbuga, 2011; Musa, Dauda, & Umar, 2016; Yu & McLellan, 2019). Such differences underscore the need for psychometric tools that are invariant across genders, ensuring equitable measurement of motivation (Guo et al., 2015). The link between achievement goals and learning strategies, including deep and surface learning approaches, has been established, with researchers suggesting that different goals are associated with distinct learning behaviors (Cano et al., 2018; Liem, Lau, & Nie, 2008). However, these relationships within the 3×2 framework remain under-explored in the context of exercise and physical education.

This study seeks to bridge these gaps by evaluating the 3×2 AGQ-E's psychometric properties among mainland Chinese adolescents. By examining factor structure, internal consistency, and measurement invariance, the study aims to validate the 3×2 model in a new cultural and domain-specific context. Additionally, by correlating achievement goals with physical activity engagement and learning strategy use in an exercise context, this research

could contribute to the broader literature on motivational psychology and inform interventions aimed at promoting physical activity among Chinese adolescents.

Methods

Participants and Procedure

This research will involve students hailing from junior and senior secondary schools in Binzhou, China, precisely from four public educational establishments—comprising two junior high and two senior high institutions. The study primarily targets students aged between 13 and 17 years, emphasizing those in the 7th and 10th grades.

To tailor the 3×2 AGQ-E for Chinese mainland adolescents, the adaptation process was undertaken. This involved a preliminary translation and back-translation procedure to maintain the semantic integrity of the questionnaire items. Subsequently, a panel of experts in educational psychology and bilingual scholars reviewed the translated version to ensure cultural relevance and comprehensibility for the targeted age group. This panel recommended modifications to certain terms to better reflect the cultural nuances, exercise context, and language use of Chinese mainland adolescents, thereby enhancing the instrument's ecological validity. The rationale behind these modifications stemmed from the recognition of cultural differences in the conceptualization of achievement and exercise. In Chinese culture, where collective success and perseverance are highly valued, certain motivational constructs may differ from those in Western settings. Therefore, adjustments were made to ensure that the questionnaire items resonated with the values and experiences of Chinese mainland students.

Ethical clearance was secured from the JKEUPM (Ethic Committee for Research Involving Human Subject at University Putra Malaysia). Prior to engaging students, it was deemed necessary to first seek the assent of junior high school educators. Participation in the study was wholly discretionary, with all participants afforded the opportunity to complete the questionnaires at the onset of the courses. The questionnaire's completion typically necessitated approximately ten minutes.

Upon concluding the data-gathering stage, 350 surveys were disseminated amongst four educational institutions, with each being duly returned, culminating in a return rate of 100%. However, a meticulous evaluation revealed that 25 of these surveys were not valid, attributable to factors such as arbitrary answer choices and redundant responses, potentially suggesting an absence of sincere engagement with the survey questions. After discarding these, 325 credible surveys were retained, translating to an efficacious

response rate of 93%. In terms of participant demographics, 152 respondents hailed from junior high school, accounting for 46.8%, while 173 were from senior high school, representing 53.2% of the cohort. Additionally, the gender ratio comprised 174 male participants (53.3%) and 151 female participants (46.5%).

Date Analysis

Data were subjected to analysis using SPSS 27.0 and AMOS 24.0. The initial phase entailed descriptive statistical analysis. In the subsequent step, a Confirmatory Factor Analysis (CFA) was executed via AMOS 24.0 to assess the proposed five-factor structure of the 3×2 AGQ-E. Recognizing the limitations of Cronbach's alpha, this study opted to gauge the internal consistency reliability of the 3×2 AGQ-E subscales using both composite reliability and Cronbach's alpha. Correlations between 3×2 AGQ-E subscales and pertinent variables were determined to evaluate discriminant validity. The final stage involved a multiple-group CFA to scrutinize the measurement invariance (such as unconstrained, measured weights, structural covariances, and measurement residuals) of the 3×2 AGQ-E across various genders of adolescent from Mainland China. Throughout the data analysis, key statistical estimates were accompanied by 95% confidence intervals to provide a range of plausible values and to enhance the interpretability of the results.

Key indices used to ascertain the model's fit comprised the chi-square value (χ^2), comparative fit index (CFI), tucker-lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Criteria for fit include CFI>0.90, TLI>0.90, SRMR≤0.08 (Browne & Cudeck, 1992), and RMSEA<0.08 for acceptably fitted models, while CFI>0.95, TLI>0.95, SRMR<0.08, and RMSEA<0.06 indicate models with superior fit (Bentler, 1995; Hair, 2009). Beyond the confirmatory factor analysis with AMOS 28 for the active behavior scale, this study employed multiple CFA to assess measurement equivalency between male and female middle school students. When determining measurement equivalence, one must sequentially test nested models like the configuration equivalence model, measured weights model, structural covariances model, and measurement residuals model. Changes in the absolute fit index serve as the equivalence test criteria. Typically, $\triangle$ CFI < 0.01 denotes a good fit for the nested model and valid equivalence testing. A 0.01 < $\triangle$ CFI < 0.02 suggests decreased fit for the nested model without a clear judgment on nested model changes. Conversely, $\triangle$ CFI > 0.02 indicates divergent fits across samples (Browne & Cudeck, 1992; D'Abundo et al., 2014; Kovács & Kovács, 2021; Williams, 2011).

Results

In evaluating the 3×2 AGQ-E, data from both educational tiers reveal commendable internal consistency reliability. For junior high school students, the Cronbach's alpha coefficient spans from 0.824 to 0.904, while for senior high school students, it extends from 0.825 to 0.886 (refer to Table 1). When considering junior high school respondents, the median value for the 3×2 AGQ-E oscillates between 4.222 and 5.130 with a standard deviation fluctuating between 1.015 and 1.404. Conversely, for the senior high school sample, the median value lies between 4.401 and 5.160, and the standard deviation ranges from 1.194 to 1.435 (as illustrated in Table 1). Collectively, these statistics underscore the robustness and efficacy of the 3×2 AGQ-E.

Table 1

Descriptive Statistics.

Dimension	Junior High Schools			Senior High Schools		
	M	*SD*	*Cronbach's α*	*M*	*SD*	*Cronbach's α*
Task-approach	5.130	1.347	0.888	5.160	1.194	0.849
Task- avoidance	4.599	1.015	0.856	5.058	1.208	0.864
Self -approach	5.007	1.404	0.875	5.104	1.310	0.849
Self-avoidance	5.092	1.376	0.904	5.078	1.293	0.886
Other-approach	4.250	1.312	0.839	4.484	1.435	0.865
Other-avoidance	4.222	1.314	0.824	4.401	1.354	0.825

Structural Validity and Internal Consistency

All subsequent Confirmatory Factor Analyses (CFA) were conducted in line with Byrne's recommendations, employing maximum likelihood estimations in conjunction with a bootstrap approach (Harrington, 2009). This technique is advantageous when addressing multivariate non-normal data. For the present study, 5,000 bootstrap samples were generated via resampling based on the guidance from Preacher, Rucker, and Hayes (2007). Scrutiny revealed that four items in the model, specifically SAP4, OAP2, OAP4, and OAV2, had factor loadings beneath the 0.5 threshold, prompting their exclusion from the model. Post this modification, the refined CFA model exhibited commendable fit as evidenced by the indices: X^2=271.331, p < 0.000, X^2/DF=1.559, GFI = 0.992, CFI = 0.977, IFI = 0.977, TLI = 0.972, and RMSEA = 0.042. This is visually represented in Figure 2.

To delve deeper into the reliability of the six-factor structure of the active behavior scale, an examination of the internal consistency of the scale and its sub-dimensions was conducted. The Confirmatory Factor Analysis (CFA) was employed to assess both the reliability and validity of the scales. Specifically, construct reliability (CR) was utilized to evaluate reliability. The CR values (0.826-0.895)

for all dimensions surpassed the 0.7 threshold, signifying robust internal consistency reliability of the scale. Convergent validity was assessed via factor loadings and the Average Variance Extracted (AVE). All standardized loading coefficients exceeded 0.6, and the factor loadings for all indicators in the model were significant at the 0.01 level. All AVE values (0.613- 0.681) surpassed 0.5, suggesting robust convergent validity for each dimension of the measurement model, as presented in Table 2.

Discriminant validity, which pertains to the distinctiveness between the latent trait represented by a specific latent variable and traits represented by other latent variables, was also examined. The square root of the AVE for each latent variable was larger than its correlation coefficient with other latent variables, confirming satisfactory discriminant validity, as detailed in Table 3.

Table 2

Structural Validity and Internal Consistency Test.

Dimension	Item	Unstd.	S. E	Z	P	Std	CR	AVE
Self-Approach	SAP1	1.000				0.836		
	SAP2	0.945	0.059	16.081	***	0.797	0.856	0.665
	SAP3	0.944	0.057	16.488	***	0.813		
Self-Avoidance	SAV1	1.000				0.853		
	SAV2	1.025	0.054	18.905	***	0.849	0.895	0.681
	SAV3	0.936	0.054	17.300	***	0.802		
	SAV4	0.926	0.054	17.108	***	0.796		
Task-Approach	TAP1	1.000				0.794		
	TAP2	0.942	0.064	14.708	***	0.768	0.869	0.624
	TAP3	0.923	0.063	14.632	***	0.765		
	TAP4	1.045	0.064	16.218	***	0.832		
Task-Avoidance	TAV1	1.000				0.75		
	TAV2	0.990	0.070	14.171	***	0.793	0.867	0.619
	TAV3	1.058	0.074	14.208	***	0.795		
	TAV4	1.050	0.073	14.449	***	0.808		
Other-Approach	OAP1	1.000				0.834		
	OAP3	0.931	0.059	15.829	***	0.804	0.855	0.663
	0AP5	0.965	0.061	15.832	***	0.804		
Other-Avoidance	OAV1	1.000				0.794		
	OAV3	1.064	0.075	14.216	***	0.793	0.826	0.613
	OAV4	1.050	0.077	13.650	***	0.761		

Table 3

Discrimination Validity Test of Potential Variables.

	SAP	SAV	TAP	TAV	OAP	OAV
SAP	**0.665**					
SAV	0.513	**0.681**				
TAP	0.620	0.596	**0.624**			
TAV	0.616	0.531	0.584	**0.619**		
OAP	0.217	0.194	0.194	0.246	**0.663**	
OAV	0.204	0.217	0.182	0.181	0.598	**0.613**
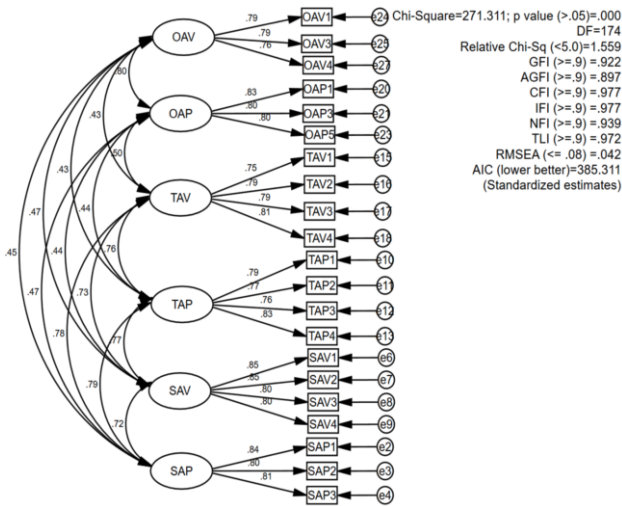
Figure 2. Confirmatory Factor Analysis.
NOTE: TAP: Task-Approach; TAV: Task-Avoidance; SAP: Self-Approach; SAV: Self-Avoidance; OAP: Other-Approach; OAV: Other -Avoidance.

Measurement Invariance Analysis

To ascertain if the measurement model exhibited consistency across gender, this study employed a multiple-group CFA to examine potential differences in the Chinese adaptation of the 3×2 AGQ-E for junior high school students between male and female participants. The study utilized a multi-cluster confirmatory factor analysis to assess the measurement invariance of the Chinese version of 3×2 AGQ-E across the gender spectrum. The stages of measurement invariance encompassed four tiers:

Unconstrained (M1), which probed the similarity of factor structures across clusters.

Measured Weights (M2), aiming to determine if factor loadings were consistent across clusters.

Structural Covariances (M3), investigating the uniformity of observed variable intercepts amongst varying groups.

Measurement Residuals (M4), which explored whether the residuals of each observed variable remained constant across different groups.

Following the methodological blueprint delineated by Vandenberg & Lance (2000), the research first introduced an unconstrained model via multi-group CFA to discern the equivalence of the 3×2 AGQ-E scale across diverse samples. The preliminary findings affirmed the morphological congruence of 3×2 AGQ-E (Gender) within the two sub-samples (χ^2=530.854, DF=348, χ^2/df=1.525, TLI=0.949, CFI=0.958, SRMR=0.382, RMSEA=0.040), and 3×2 AGQ-E (Academic level) within the two sub-samples (χ^2=557.580, DF=348, χ^2/df=1.525, TLI=0.942, CFI=0.952, SRMR=0.429, RMSEA=0.040)as tabulated in Table 4 and Table 5.

The findings indicate that the change in the Comparative Fit Index ($\triangle$ CFI) was 0.000(Gender) and 0.002(Academic level), and the change in the Tucker-Lewis Index $\triangle$ TLI = 0.005 (Gender) and $\triangle$ TLI =0.004 (Academic level) for the measured weights model in comparison to the unconstrained model. Given that both values were below the 0.010 threshold, it can be deduced that the measured weights test was validated, and the associations between the 3×2 AGQ-E items and their respective latent variables remained consistent across the gender and academic level. Subsequently, using the measured weights model as a foundation, the study further elucidated the intercept equivalence of the items to establish a structural covariances model. The results for this model, displaying $\triangle$ CFI=0.007(Gender), $\triangle$ CFI= 0.014 (Academic level) and $\triangle$ TLI=0.007 (Gender), $\triangle$ TLI= 0.008 (Academic level) values both below 0.010 except CFI with academic level, but still confirmed its validity, thereby suggesting consistent patterns in the 3×2 AGQ-E responses across gender and academic level. Building upon the structural covariances model, and with an emphasis on ensuring the error variance equivalence of the measurement item across various samples, a measurement residuals model was introduced. This model aimed to evaluate the consistent reliability of the 3×2 AGQ-E across distinct samples. The results, with $\triangle$ CFI = 0.003 (Gender), 0.001 (Academic level) and $\triangle$ TLI = 0.006 (Gender), 0.001(Academic level), affirmed that the reliability of the 3×2 AGQ-E items was consistent across diverse gender and academic level samples.

In summation, the measurement equivalence assessments confirmed the validity of the 3×2 AGQ-E structure across multiple levels of measurement invariance tests. This suggests that the 3×2 AGQ-E model is aptly suited for adolescent students in the studied region and exhibits commendable stability across genders and academic level.

Table 4

Measurement Invariance Analysis (Gender).

Model	CMIN	DF	CMIN/DF	TLI	CFI	RMSEA	SRMR	Model comparison	ΔTLI	ΔCFI
M1	530.854	348	1.525	0.949	0.958	0.040	0.382	-	-	-
M2	543.996	363	1.499	0.952	0.958	0.039	0.391	M2 VS M1	0.005	0.000
M3	577.663	405	1.426	0.959	0.960	0.036	0.476	M3 VS M2	0.007	0.007
M4	613.900	426	1.441	0.957	0.957	0.037	0.475	M4 VS M3	0.006	0.003

Table 5

Measurement Invariance Analysis (Academic Level).

Model	CMIN	DF	CMIN/DF	TLI	CFI	RMSEA	SRMR	Model comparison	ΔTLI	ΔCFI
M1	557.580	348	1.602	0.942	0.952	0.043	0.429	-	-	-
M2	565.763	364	1.559	0.946	0.954	0.042	0.423	M2 VS M1	0.004	0.002
M3	666.528	405	1.646	0.938	0.940	0.045	0.591	M3 VS M2	0.008	0.014
M4	696.938	426	1.636	0.939	0.938	0.044	0.607	M4 VS M3	0.001	0.001

Discussion

The novelty and robustness of this research are best contextualized when juxtaposed against existing studies on the Psychometric Properties of the 3×2 Achievement Goals Questionnaire. Most prior investigations focused predominantly on college students or non-Chinese adolescent demographics. This study, in a pioneering approach, ventured into the domain of mainland Chinese adolescents, specifically in an exercise context, filling a critical lacuna in the academic literature.

Our results echo some of the findings from previous studies in terms of the general validity and reliability of the original 3×2 AGQ framework. However, the uniqueness of our conclusions lies in the remarkable fit and internal consistency of the 3×2 AGQ-E, tailored for Chinese mainland adolescents. This can be attributed to a meticulous redesign of the instrument to resonate with the psychological profiles of younger respondents, juxtaposed against the foundational versions that targeted mature college students. This underscores the significance of cultural and developmental adjustments in psychometric tools, especially in contexts as diverse and intricate as mainland China.

Several aspects could elucidate the exceptional outcomes our study achieved. From the experimental design perspective, the restructuring of the 3×2 AGQ-E, with its 30 items spread across six dimensions, was a strategic endeavor to ensure relevance and alignment with the specific cohort of Chinese mainland adolescents. The terminology revisions were anchored in recognizing the nuanced cognitive and experiential differences between adolescents and older demographics. The 7-point Likert scale further allowed for more granular responses, enhancing the depth of insights extracted from participants. Additionally, the theoretical underpinnings that guided our research can't be understated. Our approach borrowed the foundational principles of the original 3×2 AGQ but layered it with the unique cultural, psychological, and developmental nuances of mainland Chinese adolescents. These theoretical adjustments, in conjunction with a methodical experimental design,

yielded results that not only resonated with prior studies but also revealed new dimensions specific to our target demographic.

From an analytical standpoint, our methodology drew inspiration from established procedures while introducing innovative measures. The employment of Confirmatory Factor Analyses, especially the multi-cluster confirmatory factor analysis, aligned with Byrne's recommendations and ensured a rigorous examination of our data. Our decision to utilize a bootstrap approach, generating 5,000 bootstrap samples as advised by Preacher and Hayes, further fortified the reliability and accuracy of our results. The commendable invariance findings across gender and academic levels underscore the versatility and broad applicability of the 3×2 AGQ-E for mainland Chinese adolescents. This is particularly pertinent given the evolving societal constructs around gender and the importance of understanding academic pressures among adolescents.

In essence, this study's innovativeness lies not just in its fresh demographic focus but also in its meticulous fusion of robust theoretical foundations, a culturally sensitive experimental design, and a rigorous analytical framework. Our findings, while echoing the broader themes of existing research, also introduce new dimensions and nuances that are seminal to the realm of education and adolescent psychology in mainland China. Future research might delve deeper into these nuances, perhaps drawing comparisons with other regional or global cohorts, but as it stands, our study presents an enriched understanding of the psychometric characteristics of 3×2 AGQ-E among Chinese mainland adolescents.

Conclusion

The data derived from this study's evaluation of the 3×2 AGQ-E instrument, specially tailored for Chinese mainland adolescents in an exercise context, offers a persuasive testimony to the instrument's reliability, robustness, and validity across multiple dimensions. Drawing from the Cronbach's alpha coefficient values, median, and standard deviation, the 3×2 AGQ-E reflects

commendable internal consistency reliability for both junior and senior high school students, filling a critical gap in the extant literature. The study, anchored on five clear objectives, finds that:

At first, the factorial validity of the 3×2 AGQ-E has been emphatically established among mainland Chinese adolescents. The process of refining the instrument using CFA, which led to the exclusion of items with factor loadings beneath the threshold, resulted in a model with an impeccable fit, as evidenced by indices like GFI, CFI, IFI, TLI, and RMSEA. Second, discriminant validity, an imperative yet often overlooked component in psychometric assessments, was thoroughly examined. The outcomes, specifically the larger square root values of AVE vis-à-vis the correlation coefficients, cement the latent variables' distinctiveness in the 3×2 AGQ-E framework. Third, the study's commitment to rigorous research is further evidenced in its exhaustive examination of the internal consistency reliability of the 3×2 AGQ-E. Construct reliability (CR) values, factor loadings, and AVE values—all comfortably exceeding their respective benchmarks—speak to the instrument's reliability and convergent validity among the target demographic. Finally. The examination of measurement invariance across gender and academic levels is a key highlight of this study, not just fulfilling but enhancing the research objectives. The meticulous multi-stage invariance tests, using multiple models, lend credence to the instrument's applicability irrespective of gender or academic standing. The consistency of the 3×2 AGQ-E across these subgroups is not just statistically significant but of profound relevance for educators, practitioners, and policymakers interested in the psychological nuances of mainland Chinese adolescents.

However, the study's findings are contextualized within specific educational settings in mainland China, and the extension of these findings to other age groups or cultural backgrounds may require additional research. This highlights a limitation in the current study and points towards a direction for future research. There is a need for subsequent studies to adapt and validate the questionnaire for younger students and to explore its applicability in different cultural settings. Future research should also investigate the instrument's relevance in varied educational landscapes, both urban and rural, to ensure its broad utility. In conclusion, while this research has made significant strides in validating the 3×2 AGQ-E and contributed to the understanding of achievement goals within the Chinese mainland adolescent population, it also opens avenues for further exploration into the complexities of motivation in physical education. The practical implications of this study for educators and policymakers are manifold, providing a data-driven basis for shaping educational practices and policies that support the health and well-being of students.

Limitation and Further Directions

While the current study marks a substantial advancement in understanding the psychometric properties of the 3×2 AGQ-E among Chinese mainland adolescents in an exercise context, it is essential to recognize its limitations. Firstly, the 3×2 AGQ-E, tailored as it is for adolescents, might not be entirely apt for younger age groups, notably elementary school students. Their cognitive frameworks and motivations are distinct from those of older adolescents. Hence, while our model showed commendable fit for the age group studied, caution should be exercised when extrapolating these findings to younger demographics. A clear limitation arises from the linguistic nuances and cultural contexts unique to mainland Chinese adolescents. The wording used in the present 3×2 AGQ-E might necessitate revision to align with the comprehension levels and experiences of elementary school students. The phrasings, while being culturally sensitive, should also factor in the significant influence wielded by parents, teachers, and peers at this developmental stage. Our focus on achievement goals rooted in an exercise context might not provide a holistic insight into the multifaceted motivations elementary students harbor. Specifically, considering the significant emphasis on the sense of relatedness and its profound relevance in Chinese culture, there's a potential that younger students might be driven more by social reasons or motivations to engage in exercise. Future research, hence, can expand on these insights. To paint a more comprehensive picture, scholars should consider embedding elements of social motivation within the achievement goals questionnaire. By doing so, it would be plausible to discern if a combined metric, one that amalgamates traditional achievement goal metrics with social motivation variables, offers a more nuanced understanding of elementary students' aspirations and motivations in exercise. Moreover, as the exercise context is central to our study, future research should also delve into other contexts.

In sum, while our study advances the discourse on achievement goals among mainland Chinese adolescents, it also underscores the need for further refined tools tailored to younger age groups, especially when seen through the prism of cultural and social motivations inherent to the Chinese ethos.

Data Availability Statement

The original contributions given in the research are available in the article/Supplementary Material; relevant authors may be contacted for more information.

Author Contributions

XL: designed, collected, analyzed data, wrote, and drafted this article. SS: data interpretation, SK and NJ: revised and approved the article. LB and JZ: Copyediting

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