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Psychometric Evaluation of the Persian Version of the Anticipatory Processing Questionnaire in an Iranian Student Population

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ABSTRACT

Objective: This study aimed to evaluate the psychometric properties of the Persian version of the Anticipatory Processing Questionnaire (APQ) in an Iranian student population.

Methods and Materials: This psychometric study was conducted on 345 university students in Tehran in 2025 selected through convenience sampling. The APQ was translated using a forward-backward procedure and administered online along with the Mistake Rumination Scale and the Southampton Mindfulness Questionnaire. Exploratory factor analysis was performed on 345 participants, confirmatory factor analysis on 200 participants, and test-retest reliability on 48 participants after four weeks.

Findings: Sampling adequacy and sphericity supported factor analysis (KMO = 0.91; $\chi^2(136) = 3394.31$, $p < .001$). Exploratory factor analysis yielded a one-factor structure with an eigenvalue of 7.57, explaining 44.58% of the variance. Confirmatory factor analysis showed acceptable fit ($\chi^2(119) = 498$, $p < .001$; CFI = 0.977; TLI = 0.974; RMSEA = 0.093; SRMR = 0.087). One item with a non-significant loading was removed. Convergent validity was supported by a positive correlation with mistake rumination ($r = .582$, $p < .001$), while divergent validity was supported by a negative correlation with mindfulness ($r = -.561$, $p < .001$). Reliability indices were satisfactory ($\alpha = .921$; CR = .882; $\omega = .930$; AVE = .501), and test-retest reliability was acceptable ($r = .763$, $p < .001$).

Conclusion: The Persian APQ demonstrated satisfactory validity and reliability and can be used as a suitable instrument for assessing anticipatory processing in Iranian student populations.

Keywords: Social Anxiety, Psychometrics, Surveys and Questionnaires, Students, Iran.

Introduction

Social anxiety is a common and disabling disorder during adolescence and young adulthood, which can have wide-ranging effects on academic functioning, interpersonal relationships, and quality of life (Huang et al., 2025). Individuals affected by it often fear negative evaluation from others, experience intense tension and worry in social situations, and consequently resort to avoidance; a pattern that, without professional intervention, can lead to the persistence of symptoms and the emergence of comorbid problems (Morrison & Heimberg, 2013; Stein & Craske, 2017). Within the framework of cognitive models of social anxiety, "fear of negative evaluation" and "shame" are identified as key components involved in the onset and persistence of this disorder (Gilbert, 2000; Wells et al., 1995). Along with these components, "anticipatory processing" is introduced as a future-oriented cognitive process that plays a central role in amplifying negative self-awareness, exaggerating social threat, and reinforcing avoidance behaviors (Vassilopoulos, 2004; Wong & Moulds, 2011).

Anticipatory processing refers to the mental recreation of scenarios involving failure, humiliation, and negative evaluation before entering social interactions; scenarios that increase pre-interaction anxiety, disrupt performance, and sustain the "threat anticipation–anxiety–negative experience–reinforcement of ineffective beliefs" cycle (Hinrichsen & Clark, 2003; Hirsch & Clark, 2004). Research findings indicate that the frequency and intensity of involvement in anticipatory processing are correlated with the severity of social anxiety, and this process is a distinct construct from post-event rumination (Vassilopoulos, 2004; Wong & Moulds, 2011).

In newer approaches, anticipatory processing is linked to deficits in attention control and bias toward social threat cues, such that the activation of this process intensifies self-focused attention and threat monitoring, thereby increasing the likelihood of prediction errors and avoidance behaviors (Hinrichsen & Clark, 2003). Neuroscientific evidence also supports this image: hyperactivation of the amygdala and engagement of the default network during future-oriented threat scenario construction are associated with the persistence of negative self-awareness and the projection of pessimistic outcomes (Smith, 2020). On the other hand, mindfulness-based interventions have shown a reduction in cognitive involvement with the future and a shift of attention back to the present moment, which decreases anticipatory processing and improves social functioning; a pattern that theoretically aligns with the structural incompatibility between anticipatory processing and mindfulness (Hayes-Skelton & Marando-Blanck, 2019; Wells et al., 2020).

Anticipatory processing is expected to be aligned with ineffective future-oriented cognitive patterns, such as "rumination over mistakes," and show an inverse relationship with "mindfulness," which focuses on conscious presence and reduces cognitive engagement with future-threatening scenarios (Hayes, 2017; Hirsch & Clark, 2004; Vassilopoulos, 2004; Wells, 1995).

Recent epidemiological trends have further emphasized the need for accurate measurement of this process in young populations (Vos et al., 2020). New reports indicate an increase in the burden of social anxiety among students and its negative effects on quality of life, academic participation, and persistence in education (Lee, 2024; Wang et al., 2024; Zhao et al., 2024). This context aligns with international findings on the higher-than-expected prevalence and the high rate of undiagnosed cases in youth, highlighting the need for reliable screening and process assessment tools (Jefferies & Ungar, 2020). Therefore, precise and culturally adapted assessment of anticipatory processing is crucial for research as well as for the design of targeted interventions in student populations (which are undergoing transitions to independence, facing academic pressures, and evaluative situations) (Morrison & Heimberg, 2013; Stein & Craske, 2017).

Furthermore, recent integrative evidence suggests that anticipatory processing is not merely a consequence of social anxiety but serves as a maintaining mechanism and even plays a causal-role in predicting future avoidance and intensifying the anxiety cycle (Schmidt, 2023). Taken together, the intersection of cognitive, neuroscientific, and new intervention findings solidifies the role of anticipatory processing as a key target for assessment and treatment in student populations, reinforcing the need to examine the psychometric properties of its Persian version for local research and the development of evidence-based interventions

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(Hayes, 2017; Hirsch & Clark, 2004; Lee, 2024; Schmidt, 2023; Smith, 2020; Wells et al., 2020).

Despite the widespread use of the anticipatory processing questionnaire in international literature, the 17-item tool that specifically measures the tendency to engage in future-oriented processing before threatening social situations (Vassilopoulos, 2004) has not yet been systematically examined in Iran. Therefore, the aim of this study wasto investigate the psychometric properties of the Anticipatory Processing Questionnaire (APQ) in the Iranian population.

Methods and Materials

Study Design

It is considered a test development study, conducted as part of a descriptive research design. The study used correlation methods, goodness-of-fit analysis, factor analysis, and reliability analysis to explore the relationships and alignment between the variables assessed by the questionnaires and the theoretical foundations, as well as to examine psychometrics properties of the questionnaires.

Population, Sample, and Sampling Method

The population of this study consisted of all university students in Tehran in the year 2025. For data collection, a convenience sampling method was used, and the questionnaires was designed and distributed online. Based on the proposed criterion by (Kline, 2013), which recommends allocating at least 15 participants per item, the initial sample size was determined. Taking into account a 20% potential dropout rate, a total of 345 individuals were selected for this phase. For exploratory factor analysis, 345 participants participated, while 200 participants were included for confirmatory factor analysis. To assess reliability via test-retest, the questionnaire was sent again to 48 participants after four weeks, and its reliability coefficient was calculated.

Inclusion criteria for the study included being aged between 18 and 30 years, being enrolled in the year 2025, and the ability to use a computer or smartphone and related applications. Exclusion criteria included incomplete questionnaire responses and withdrawal from the study at any stage of the research process. All inclusion and exclusion criteria were reviewed and assessed before providing the questionnaire link to the participants.

Measurement Tools

Demographic Information Questionnaire: Respondents answered demographic variables (age, education, gender) in this questionnaire.

Anticipatory Processing Questionnaire: This tool was developed by (Vassilopoulos, 2004) to assess mental processing before engaging in social situations. The conceptual structure of this questionnaire is based on Clark and Wells' theoretical model of social phobia and related studies on post-event processing (Rachman et al., 2000). The questionnaire includes 17 self-report items, asking participants to think about a recent social situation and rate their mental engagement with it before it occurred, using a visual analogue scale from 0 (not at all) to 100 (intensely). The introductory text of the questionnaire is: "According to recent research, most individuals experience anxiety before entering social situations (such as a party, a meeting, or meeting new people). Have you experienced such anxiety before a social situation in the past few months? If so, please answer the following questions." Higher scores on this scale indicate more intense anticipatory processing. (Vassilopoulos, 2004) reported an internal consistency of 0.91 using Cronbach's alpha, indicating good internal consistency and high reliability. The questionnaire has also shown significant positive correlations with social anxiety symptoms. In the present study, the psychometric properties of the Persian version of this questionnaire were examined.

The Mistake Rumination Scale: This scale was developed by (Flett et al., 2020) to measure the tendency to ruminate over personal mistakes and consists of 7 items, scored using a 4-point Likert scale (Not at all, a little, somewhat, a lot). The participant is asked to recall their most recent mistake and then answer the items. An example item is: "How much did you think about why you can't avoid making such mistakes again?" The scoring follows a four-option scale, where "Not at all" scores 1, "a little" scores 2, "somewhat" scores 3, and "a lot" scores 4, so the total score ranges from 7 to 28, with higher scores indicating more rumination over mistakes. In the original version, the one-factor structure of the scale was confirmed using confirmatory factor analysis, and the scale showed good internal consistency, with a Cronbach's alpha of 0.84. The scores on this scale were significantly correlated with perfectionism, negative

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rumination, depression, and social anxiety. Rumination over mistakes, beyond the dimensions of perfectionism and other cognitive indicators, accounted for additional variance in depression. These findings indicate the scale's construct validity, convergent validity, and adequate discriminant validity. The psychometric properties of the Persian version of this scale in Iran were investigated by (Abdollahi et al., 2021) with 300 undergraduate students. In this study, content validity indices were calculated using content validity ratio and content validity index for each item, both of which were found to be acceptable and above the suggested thresholds (content validity ratio > 0.78, content validity index > 0.80). The composite reliability of the scale was 0.74, and the Cronbach's alpha was 0.81, indicating good internal reliability. Confirmatory factor analysis showed that all factor loadings were greater than 0.66 and significant at the 0.001 level. The model fit indices (including GFI, CFI, and RMSEA) were within acceptable ranges, supporting the construct validity and the one-factor structure of the Persian version. Furthermore, convergent validity was confirmed through significant positive correlations between this scale and related scales (such as rumination and negative emotional indicators) at an acceptable level (around 0.50). In the present study, the total score of this scale was used as an index of mistake rumination and was employed to assess the convergent validity of the Anticipatory Processing Questionnaire.

Southampton Mindfulness Questionnaire: This self-report questionnaire was developed by Chadwick et al., (2008) and consists of 16 items. The scale lacks subscales and was designed to assess mindfulness levels in clinical and general populations. This tool focuses on individuals' mental engagement with negative thoughts, acceptance levels, and awareness of thoughts, assessing their mindfulness in everyday situations. Scoring is done using a 7-point Likert scale. The options are: "Strongly disagree" (score 0), "Almost disagree" (score 1), "Disagree" (score 2), "Neither agree nor disagree" (score 3), "Agree" (score 4), "Almost agree" (score 5), and "Strongly agree" (score 6). Furthermore, items 2, 3, 6, 8, 12, 13, 14, and 16 are reverse-scored. The total score range is between 0 and 96, where higher scores indicate higher mindfulness levels, and lower scores indicate lower mindfulness. In Chadwick et al., (2008) study, Cronbach's alpha for this scale was 0.82 in the general population, 0.89 in the clinical population, and 0.82 for the total sample. Principal component analysis showed that both three-factor and one-factor interpretations of the scale were feasible. The concurrent validity of this scale was confirmed with a significant positive correlation of 0.60 with the Brown and Ryan Mindfulness Scale. This tool showed a negative correlation of -0.62 with positive emotion and a negative correlation of -0.34 with negative emotion and psychotic symptoms. In Foroughi et al., (2019) study, reliability for the engagement with thoughts factor was 0.78, the acceptance factor was 0.69, and the awareness of thoughts factor was 0.62. Exploratory factor analysis revealed three factors that together explained 51.50% of the variance in mindfulness. In the present study, this questionnaire was used to assess the divergent validity of the Anticipatory Processing Questionnaire.

Procedure

This research was conducted in a descriptive design with a psychometric approach. After preparing the Persian version of the Anticipatory Processing Questionnaire, the online survey link containing the research information, informed consent form, and the set of questionnaires was distributed among students from several universities in Tehran via social media and university notification systems. Participation in the study was completely voluntary, and participants could withdraw from the study at any stage without any consequences.

Research Execution Steps

The research was carried out in several stages: 1. Initial translation and cultural adaptation of the questionnaire, followed by a review of its face and content validity by a group of experts. 2. A pilot test conducted on a small group of students (5 participants) to evaluate item clarity, completion time, and potential issues. 3. Minor revisions based on feedback from participants and experts. 4. Collection of main data from the student sample, followed by psychometric analysis (factor structure, reliability, and convergent and divergent validity).

Ethical Considerations

The online questionnaire's first page clearly explained the research purpose, the voluntary nature of participation, the confidentiality of information, and the option to withdraw at any time. Access to the items was activated only upon informed consent. No personal

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identification information (name, student number, or contact details) was collected from participants, and the data were reported in aggregate and group form. Also the ethical code was obtained for the research: IR.ACECR.USC.REC.1404.013.

Translation and Cultural Adaptation Process

The translation of the Anticipatory Processing Questionnaire followed the standard forward-backward translation procedure. Initially, two translators proficient in both English and Persian independently translated the English version of the questionnaire into Persian. A panel of three clinical psychology and linguistics experts compared the two translations with the original version and reached a consensus on the final Persian version. In the next stage, an independent translator, unaware of the original version, back-translated the Persian version into English. The back-translated version was compared with the original to ensure that the conceptual equivalences were maintained. Finally, several students evaluated the final Persian version for clarity, simplicity, and comprehensibility of the items, and minor language revisions were made.

Data Analysis

After data cleaning, analyses were conducted using SPSS version 22 and AMOS version 22. Descriptive statistics, including mean, standard deviation, skewness, and kurtosis, were used. Internal consistency was assessed using Cronbach's alpha, and test-retest reliability was calculated with correlation coefficients over a four-week interval. For construct validity testing, exploratory factor analysis (if applicable) and then confirmatory factor analysis based on the proposed one-factor/multi-factor model were conducted. Convergent and divergent validity was determined by correlating the Anticipatory Processing Questionnaire scores with related (e.g., The Mistake Rumination) and unrelated (e.g., Mindfulness) scales. The significance level for all tests was set at 0.05.

Findings and Results

In this study, a total of 345 students from various universities in Tehran in the year 2025 participated. The participants' ages ranged from 18 to 30 years, with a mean age of 22.41 years (standard deviation = 2.58). Regarding gender, 226 participants were female (65.5%) and 119 were male (34.5%). In terms of academic level, 246 participants (71.3%) were undergraduate students, and 99 (28.7%) were graduate students (Master's and PhD). To assess the factor structure of the scale in the Iranian population, exploratory factor analysis was initially conducted. In the first step, to ensure the assumptions of exploratory factor analysis were met, the Kolmogorov-Smirnov test was performed, confirming the normality of the variables ($p > 0.05$). After performing exploratory factor analysis and extracting the initial structure, confirmatory factor analysis was conducted on the second half of the sample. At this stage, the results of the Mardia normality test indicated the normality of the data; therefore, maximum likelihood estimation was used for confirmatory factor analysis.

To evaluate the suitability of the scale items for exploratory factor analysis, the corrected item-total correlation of each item was examined (Table 1). The item-total correlations ranged from 0.27 to 0.78, and since the item correlation values fell within an acceptable range (Farahani & Roshan Chesli, 2020), it was concluded that the item-total correlations were adequate. After ensuring the adequacy of the data for exploratory factor analysis and testing the Bartlett's test of sphericity and the sampling adequacy (KMO = 0.91), the result of Bartlett's test yielded $\chi^2(136) = 3394.31$, with a significance level ($P < 0.001$). This indicates that there was sufficient correlation among the variables. Based on the statistical adequacy of the data, the results of the exploratory factor analysis were relied upon (Farahani & Roshan Chesli, 2020).

When the instrument under review has a unidimensional structure, rotation methods (whether orthogonal or oblique) are not necessary. Generally, rotation is used when multiple factors are expected to be extracted, and the researcher needs to facilitate the interpretation and naming of distinct factors (Tabachnick & Fidell, 2019). The results showed that one factor with an eigenvalue of 7.57 was extracted, which explained 44.58% of the total variance of the Anticipatory Processing Questionnaire. According to the Kaiser criterion (eigenvalue greater than 1), the extraction of one factor indicates that the questionnaire has a unidimensional structure and the items primarily measure a common construct. Since the explained variance was more than 40%, it can be concluded that the questionnaire has an acceptable factor structure, and

the extracted factor explained a significant proportion of the total variance. This finding is also consistent with the theoretical foundations of the instrument and indicates that the construct being studied can be explained by one main factor. The results of the factor loadings for the main factor of the Anticipatory Processing Questionnaire are presented in Table 1.

Table 1

Principal Component Analysis and Factor Loadings of the Anticipatory Processing Questionnaire

Items	Factor 1
4	0.84
2	0.81
3	0.81
5	0.81
8	0.78
6	0.77
11	0.74
1	0.72
7	0.65
10	0.64
15	0.63
12	0.63
14	0.61
13	0.55
17	0.51
16	0.35
9	-0.05

In Table 1, the results of the factor loadings of the main factor for the 17 items of the Anticipatory Processing Questionnaire are reported. As observed, most items have relatively high and acceptable factor loadings on the main factor. Item 9, with a negative factor loading (0.05), showed no meaningful correlation with the main factor and was excluded from the final scores of the scale. Given that the sample size for exploratory factor analysis was 345 participants, confirmatory factor analysis was conducted on another sample of 200 participants to verify the extracted factor structure.

To perform confirmatory factor analysis and ensure a good model fit, goodness-of-fit indices were computed. The χ^2 value was 498 with 119 degrees of freedom, and the result was significant ($P < 0.001$). The goodness-of-fit indices showed that CFI = 0.977 and TLI = 0.974, which were both above the acceptable threshold (0.90). The RMSEA = 0.093 and SRMR = 0.087 were calculated, indicating that the unidimensional model had a good fit. In other words, most items have significant and relatively strong factor loadings and confirm the main structure of the questionnaire.

Table 2

Factor Loadings in Confirmatory Factor Analysis of the Anticipatory Processing Questionnaire

Item	Estimate Coefficient	Standard Error	Z Value	p-value
1	1.00	0.00		
2	1.20	0.04	27.24	<0.001
3	1.21	0.04	29.03	<0.001
4	1.18	0.04	28.06	<0.001
5	1.14	0.04	26.39	<0.001
6	1.04	0.05	22.94	<0.001
7	0.86	0.06	13.73	<0.001
8	1.11	0.04	25.02	<0.001
9	0.05	0.07	0.70	0.49
10	0.88	0.06	15.11	<0.001
11	1.06	0.05	23.39	<0.001
12	0.91	0.06	16.02	<0.001
13	0.78	0.06	14.11	<0.001
14	0.77	0.06	12.10	<0.001

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15	0.84	0.06	13.63	<0.001
16	0.43	0.07	6.24	<0.001
17	0.77	0.06	12.17	<0.001

The results of the confirmatory factor analysis indicate that most items of the Anticipatory Processing Questionnaire have high and significant standardized factor loadings on the main factor. In contrast, item 9, with an estimate coefficient of 0.05 and a significance level of 0.49, showed no significant relationship with the main factor and did not contribute to explaining the construct. Overall, the results indicated that the unidimensional structure of the questionnaire was confirmed; however, item 9 was excluded from the final version based on findings from both exploratory and confirmatory factor analyses. To assess the convergent validity of the Anticipatory Processing Questionnaire, its correlation with another established tool measuring a similar construct was examined. The Mistake Rumination Scale was used for this purpose, which has been validated in multiple studies.

Table 3

Pearson Correlation Coefficient between Anticipatory Processing and Mistake Rumination and Mindfulness

Variables	Pearson Correlation	R^2	Significance Level
Anticipatory Processing and Mistake Rumination	0.582	0.34	0.001
Anticipatory Processing and Mindfulness	-0.561	0.31	0.001

As seen in Table 3, the Pearson correlation coefficient between the Anticipatory Processing Questionnaire and the Mistake Rumination Scale was 0.582, with a significance level of $P < 0.001$. This result indicates a significant positive correlation between the two variables. Therefore, it can be concluded that the Anticipatory Processing Questionnaire has acceptable convergent validity.

To examine the divergent validity of the Anticipatory Processing Questionnaire, its correlation with another psychometric tool measuring a distinct construct was assessed. The Southampton Mindfulness Questionnaire, which has been validated in various studies, was used for this purpose. The Pearson correlation coefficient between the scores of the Anticipatory Processing Questionnaire and the Southampton Mindfulness Questionnaire was -0.561, with a significance level of $P < 0.001$. Thus, this negative and significant correlation confirms that the two tools measure distinct and non-overlapping constructs, supporting the satisfactory divergent validity of the Anticipatory Processing Questionnaire.

To evaluate the internal consistency reliability of the Anticipatory Processing Questionnaire, several psychometric indices were computed.

Table 4

Internal Consistency Reliability Indices of the Anticipatory Processing Questionnaire

Scale/Validity	Number of Items	Cronbach's Alpha	Composite Reliability (CR)	McDonald's Omega	AVE
Anticipatory Processing	16	0.921	0.882	0.930	0.501

Based on the results in Table 4, all the reliability indices indicate good internal consistency for the Anticipatory Processing Questionnaire. The Cronbach's alpha for the 16 items of the questionnaire was calculated as 0.921, which indicates high internal consistency. The composite reliability (CR) was 0.882, which exceeds the minimum acceptable threshold (0.70), indicating the coherence and stability of the items in measuring the intended construct. Moreover, McDonald's Omega was reported as 0.930, further confirming the reliability of the scale.

Additionally, the average variance extracted was calculated as 0.501, which exceeds the suggested threshold (0.50), indicating that more than half of the variance of the items is explained by the common latent factor. This result shows that the Anticipatory

Processing Questionnaire is not only highly reliable but also has good convergent validity, with the items contributing significantly to explaining the main construct. Overall, it can be concluded that the instrument has strong internal consistency reliability. To assess the test-retest reliability, Pearson correlation coefficients were computed after four weeks with 48 participants from the sample.

Table 5

Test-Retest Reliability of the Anticipatory Processing Questionnaire

Scale/Validity	Pearson Correlation	Significance Level
Anticipatory Processing	0.763	0.001

The results of the test-retest reliability of the Anticipatory Processing Questionnaire show that the Pearson correlation coefficient between the two administrations of the questionnaire (with a four-week interval) for 48 participants was 0.763, with a significance level of $P < 0.001$. This indicates that the Anticipatory Processing Questionnaire has good stability over time, and its results are reliable. Therefore, it can be concluded that the instrument has excellent test-retest reliability.

Discussion and Conclusion

Based on the analysis of the data obtained and in line with previous research, it can be concluded that the Anticipatory Processing Questionnaire (APQ) is valid and reliable for use in the Iranian population and measures the same construct as described by cognitive models of social anxiety. The correlation matrix is sufficiently rich to represent a common underlying structure. The correlation of each item with the corrected total score ranged from 0.27 to 0.78, indicating that the items align with the shared conceptual core, as shown by accepted criteria.

In exploratory factor analysis, extracting a single factor with an eigenvalue of 7.57, explaining 44.58% of the total variance, supports the unidimensionality of the tool. The unidimensionality is consistent with the theoretical notion of the "cognitive feedback loop" in the social anxiety cycle, which activates threat and failure scenarios before social encounters and feeds into other components like negative self-awareness, avoidance, and post-event rumination. Therefore, the use of rotation methods was unnecessary, as the theoretical expectation from the outset was a single construct, and the goal was to confirm the convergence of factor loadings on this common factor.

Another important aspect concerns the item structure of the tool. As noted in the instrument section, three items of the questionnaire are not included in the total score calculation. Item 17 is inherently a binary screening question (Yes/No), used only to confirm the experience of a recent social situation, and its response scale (Yes/No) is inconsistent with the 0–100 scale of the other items. As a result, no score is calculated for this item, both in the original and the Persian version. Additionally, items 9 did not exhibit desirable behavior in preliminary statistical analyses (correlations with the total score and factor indices), with item 9, in particular, showing low and non-significant factor loadings in exploratory and confirmatory analyses. Thus, this item was excluded from the scoring process in the Persian version, and the final score of the questionnaire is calculated based on the remaining 16 items. While this strengthens the factor consistency and internal coherence of the tool, it may somewhat limit the content coverage of the construct, and future studies should reassess the role of these items in larger and more diverse samples.

To confirm the structure of the questionnaire, confirmatory factor analysis was conducted on an independent sample, and the goodness-of-fit indices provided a convincing image of the adequacy of the unidimensional model. Although the root mean square error of approximation (RMSEA) slightly exceeded the more stringent thresholds, the simultaneous combination of fit indices, including Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), was excellent, alongside the significant factor loadings of most items, confirming that the unidimensional model fits the data well. This result aligns with theoretical frameworks that regard anticipatory processing as an integrated, future-oriented process.

Convergent validity was assessed through correlation with the Mistake Rumination Scale, and the significant positive correlation observed is theoretically expected, as both processes (despite temporal differences) rely on threat-oriented processing and exaggerated negative outcome estimation. Anticipatory processing before events simulates failure scenarios and negative judgments, while post-event rumination reproduces the same negative content. Therefore, the observed strength of the correlation suggests that the current tool measures the same cognitive network and is close to the "attention-cognition syndrome" described in metacognitive frameworks.

In contrast, divergent validity was assessed using the Southampton Mindfulness Questionnaire, and the observed inverse and significant correlation aligns with theoretical expectations, as mindfulness emphasizes present-moment awareness, detachment from judgment, and reduced engagement with future-oriented scenarios, thereby helping to silence the anticipatory threat cycle. Thus, the more active anticipatory processing is, the lower the levels of mindfulness are expected to be. This statistical and theoretical symmetry not only confirms the distinction between constructs but also suggests that clinical interventions such as mindfulness training and metacognitive approaches could reduce the intensity of anticipatory processing by enhancing attentional flexibility.

The reliability of the tool was also confirmed using several methods: Cronbach's alpha, McDonald's omega, and composite reliability all indicated good internal consistency, meaning that the items cohesively measure a single construct with minimal measurement error. The average variance extracted (Chadwick et al. 2008) indicated that more than half of the variance of the items is explained by the common latent factor, further confirming both reliability and convergent validity within the framework of construct measurement. Additionally, test-retest reliability, measured after a four-week interval, showed that the questionnaire scores remain stable over time, meaning that what is being measured is a relatively stable and process-based characteristic, not a fluctuating, situational one.

In conclusion, the evidence from exploratory and confirmatory factor analyses, the positive and significant correlation with the mistake rumination as a convergent validity indicator, the negative and significant correlation with Mindfulness as a divergent validity indicator, and the high internal consistency and satisfactory temporal stability provide a clear picture of the psychometric suitability of the Anticipatory Processing Questionnaire for use in the Iranian population. The unidimensionality of the scale is in line with the dominant theoretical frameworks that view anticipatory processing as the "starting point" of the social anxiety cycle, and it suggests that the tool can be used for research and clinical assessment in Iran.

This study had several limitations that should be considered when interpreting the findings. First, the sampling was conducted using a convenience method from university students in Tehran, and therefore, generalizing the results to other age groups, non-student populations, and clinical populations should be done with caution. Third, the study design was mainly cross-sectional, and while the test-retest index was obtained over a short-term interval, the long-term stability of the scores and the sensitivity of the scale to therapeutic changes cannot be definitively assessed. Lastly, the lack of objective indices (such as structured clinical assessments or behavioral tasks related to social anxiety) limits the scope of inferences regarding the tool's relationship with real-world social performance outcomes.

Given these limitations, future research could contribute to enriching the evidence on the Anticipatory Processing Questionnaire in several directions. First, it is recommended to examine the psychometric properties of this tool in non-student samples and clinical populations with social anxiety and other related disorders to clarify its applicability in diagnostic and therapeutic settings. Second, multicenter studies in various cities and provinces of the country could assess cultural heterogeneity and investigate potential inequalities in factor structure and reliability indices. Third, longitudinal and interventional studies should be employed to test the predictive role of anticipatory processing scores in the trajectory of social anxiety, behavioral avoidance, and academic performance, as well as to examine the tool's sensitivity to treatment-related changes (such as cognitive-behavioral or mindfulness-based interventions). Fourth, examining item performance and assessing measurement invariance in subgroups based on gender, age, and

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severity of social anxiety, as well as determining optimal cut-off points for screening at-risk individuals, could enhance the clinical application of this questionnaire.

Conclusion

In summary, the findings of this study showed that the Persian version of the Anticipatory Processing Questionnaire has a unidimensional, reliable structure, suitable construct validity, good convergent validity with the Mistake Rumination scale, and acceptable divergent validity with Mindfulness. Its internal consistency and temporal stability were found to be satisfactory. Therefore, this tool can be used as a valid and effective measure for assessing future-oriented threat processing in social situations in Iranian student populations, and it can be applied in research studies and initial clinical screenings. However, its application in other populations and clinical settings should be done with attention to the aforementioned limitations and in light of future research evidence.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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