

A Psychometric Analysis of the Chinese Version of the Camouflaging Autistic Traits Questionnaire Among Adolescents in Chinese Mainland

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Abstract

Background

Autistic traits are continuously distributed across the general population, and adolescents become increasingly sensitive to social interactions and self-image. Research on social camouflaging among adolescents is therefore critical to understanding their social development. This study validated the simplified Chinese version of the Camouflaging Autistic Traits Questionnaire (CAT-Q-Ch) among adolescents in Chinese mainland, aiming to establish a reliable tool for investigating adolescent social camouflaging.

Methods

Participants were randomly recruited from four middle schools and three universities in Chinese mainland. The first sample, comprising 805 valid questionnaires, was used to explore and verify the latent factor structure of the scale. The second sample with 269 valid responses was used for additional reliability and validity assessments. Exploratory factor analysis and basic psychometric analyses were performed using SPSS 25.0, while confirmatory factor analysis and measurement invariance tests were conducted in Mplus 7.4. Quantitative semantic analysis was further implemented to examine the discriminant validity of the simplified CAT-Q-Ch against other relevant measures.

Results

Items with factor loadings below 0.40 and substantial cross-loadings were sequentially removed before exploratory factor analysis was carried out on the remaining items. The factor structure of the retained items matched that of the original scale, with the extracted factors accounting for 54.30% of the total variance. Confirmatory factor analysis (CFA) yielded an acceptable fit for the three-factor model. Multigroup CFA confirmed strict cross-age and cross-gender measurement invariance for the three-factor simplified CAT-Q-Ch. The total scale and its subscales demonstrated adequate internal consistency, test-retest reliability, satisfactory criterion-related validity and discriminant validity.

Conclusions

The revised simplified CAT-Q-Ch possesses sound psychometric properties of reliability and validity. It can serve as a validated instrument to assess social camouflaging in adolescents.

Introduction

Social Camouflaging and Its Unique Characteristics

Social camouflaging refers to a set of behavioral strategies employed during social interactions, in which individuals consume substantial personal resources to conceal and alleviate social deficits, such as impaired ability to infer others' mental states, interpersonal hypersensitivity, and social avoidance (Hull et al., 2017). The Camouflaging Autistic Traits Questionnaire (CAT-Q) is the most commonly used instrument, which included three categories: masking, compensation, and assimilation (Greig et al., 2026; Liu et al., 2024). Social camouflaging is more common among neurodivergent, particularly autistic people with social communication impairments. By learning standardized social rules and hiding prominent autistic traits, such individuals aim to minimize perceivable differences from neurotypical individuals, promote social connections, and optimize social adaptation (Baldwin & Costley, 2016).

Existing empirical research has identified a positive correlation between the degree of social camouflaging and the level of autistic traits (Hull et al., 2019). Higher autistic traits contribute to greater social difficulties, while social camouflaging effectively helps autistic individuals engage in social interactions in neurotypical-dominated contexts and develop positive interpersonal relationships (Hull et al., 2017; Lai et al., 2011; Kopp & Gillberg, 2011). Furthermore, autistic traits are continuously distributed in the general population (Constantino & Todd, 2003). Research also indicates that the association between autistic traits and social camouflaging is stronger in neurotypical individuals than autistic individuals, demonstrating that social camouflaging is also prevalent among neurotypical individuals (Bernardin, Mason, et al., 2021; Greig et al., 2026; Milner et al., 2023).

Some scholars conceptualize social camouflaging as a prevalent form of impression management among neurotypical individuals (Ai et al., 2022). Impression management refers to the process in which individuals adjust their self-presentation based on situational cues and interaction partners' characteristics to shape others' interpersonal perceptions (Yan et al., 2010). Early social psychological research on the "chameleon effect" framed impression management as deceptive social masking (Goffman, 1959), suggesting partial conceptual overlap between impression management and social camouflaging. Additionally, social camouflaging has been regarded as a construct similar to self-monitoring (Bernardin et al., 2021). Self-monitoring is defined as individuals' sensitivity to others' expressive behaviors and their ability to flexibly adjust self-presentation across diverse social contexts (Lennox & Wolfe, 1984). Both social camouflaging and self-monitoring involve behavioral modifications aimed at regulating others' impressions of oneself (Jorgenson et al., 2020; Schneid & Raz, 2020).

According to the multilevel framework of impression management and autistic camouflaging, social camouflaging serves as a distinct subconstruct that requires independent investigation (Ai et al., 2022). Empirical studies have demonstrated divergent associations of self-monitoring and social camouflaging with psychological well-being: self-monitoring positively predicts well-being, whereas social camouflaging yields negative predictive effects (Selvidge et al., 2008; Hull et al., 2019). Higher levels of social camouflaging are linked to increased perceived stress (Cage & Troxell-Whitman, 2019; Liu et al., 2024). Furthermore, social camouflaging acts as a unique risk factor for suicidality among autistic individuals, even after controlling for age, gender, depression, anxiety, and life satisfaction (Cassidy et al., 2020). Qualitative interview data from autistic adults further indicate that camouflaging among friends

and family induces interpersonal guilt, reduced self-concept clarity, and persistent identity uncertainty caused by long-term behavioral pretence (Bargiela et al., 2016; Hull et al., 2017). These adverse outcomes may be explained by the resource-depletion mechanism: individuals with inherent social difficulties must consume substantial personal resources to adapt to situational social demands and maintain normative social interactions, and prolonged resource exhaustion ultimately exacerbates negative emotional experiences (Head et al., 2014; Hull et al., 2021). Taken together, exploring social camouflaging in the neurotypical population is crucial for elucidating the developmental mechanisms underlying individual mental health.

Adolescents and Social Camouflaging

Unlike autistic individuals, social camouflaging in neurotypical populations is closely tied to age-specific psychological developmental features, with adolescents showing a greater tendency to engage in camouflaging behaviors (Bernardin et al., 2021). Driven by heightened self-awareness and a strong desire for peer acceptance, adolescents become increasingly sensitive to interpersonal evaluation and others' perceptions of them (Erikson, 1968). Meanwhile, their social cognitive capacities are still immature, leaving them with limited social skills and experience to navigate increasingly complex social environments. This developmental limitation motivates adolescents to adopt social camouflaging to compensate for insufficient social competence (Andrews et al., 2021; Bernardin, Mason, et al., 2021).

Although social camouflaging is common in the neurotypical population, its behavioral manifestations and psychological impacts vary across groups, highlighting the need for targeted group-specific investigation. Existing research indicates that adolescent autistic and neurotypical individuals show comparable levels of masking and compensation, whereas neurotypical adolescents demonstrate significantly lower assimilation (Jorgenson et al., 2020; Liu et al., 2024). On the one hand, adolescents frequently encounter social challenges that exceed their current social capabilities, prompting them to employ masking and compensation to optimize social performance. On the other hand, neurotypical adolescents are in a critical stage of identity formation, during which they are highly sensitive to others' evaluations and motivated to maintain a favorable self-image. Accordingly, they actively adjust their self-presentation to conform to social expectations and peer perspectives (Kumru & Thompson, 2003). Notably, assimilation is the only subcomponent that uniquely predicts depressive and anxiety symptoms among neurotypical individuals (Loo, 2020; Ross et al., 2022). This evidence indicates that even mild assimilation behaviors can confer negative emotional outcomes for neurotypical adolescents.

Given the extended developmental timeline of adolescence, it is essential to validate the applicability of the CAT-Q across broad adolescent age ranges. Cumulative evidence from adolescent and adult studies suggests a complex age-related pattern of social camouflaging among neurotypical youth. Specifically, social camouflaging levels are higher in late adolescence than in middle adolescence, while emerging adulthood is accompanied by reduced camouflaging behaviors relative to late adolescence (Bernardin, Lewis, et al., 2021; Belcher et al., 2021; Dell'Osso, Cremone, Chiarantini, et al., 2022; Jorgenson et al., 2020). Broader age-spanning samples further reveal divergent developmental trajectories of social camouflaging between neurotypical and autistic groups across age (Lundin Remnélius & Bölte, 2023).

Collectively, investigating social camouflaging throughout the full adolescent period not only advances our understanding of adolescent socioemotional development, but also provides novel implications for promoting social adaptation among autistic people.

The Need for CAT-Q Localization

Research interest in social camouflaging has increased substantially in recent years, leading to the continuous development and psychometric validation of multiple language versions of the CAT-Q. Despite its widespread application, cross-version discrepancies remain in the CAT-Q's factor structure and item distribution across cultural contexts. For example, the Swedish and German CAT-Q versions retained the original three-factor structure after removing items with poor discriminatory power among autistic and neurotypical samples (Lundin Remnélius & Bölte, 2023; Boettcher et al., 2026). The Dutch CAT-Q exhibits adequate reliability but fails to achieve sufficient measurement invariance (van der Putten et al., 2023). The traditional Chinese CAT-Q (CAT-Q-Ch) required item deletion due to unsatisfactory factor loadings and ambiguous interpretability, and further merged masking and compensation into a unified dimension (Liu et al., 2024). Another general population study of the CAT-Q preserved the original factor structure but relocated two items across subscales (Ai et al., 2024). In contrast, the Italian CAT-Q demonstrated robust reliability and validity, with its factor structure and item allocation fully consistent with the original scale (Dell'Osso et al., 2022). Overall, these cross-cultural differences highlight the necessity of context-specific revision and adaptation to optimize the CAT-Q's psychometric performance.

The traditional CAT-Q-Ch has been psychometrically validated among adolescents in Taiwan, China, providing a solid foundation for exploring social camouflaging in collectivist cultural contexts (Liu et al., 2024). Individuals growing up in collectivist cultures tend to adhere to social norms and attach great importance to interpersonal bonding (Triandis, 2001). Even so, cultural influences on social camouflaging operate at a broader macro-system level. According to ecological systems theory, human development is shaped by continuous bidirectional interactions between individuals and multiple nested environmental systems. The macrosystem constitutes a broad overarching cultural framework, rather than specific tangible environments, that reshapes microsystem conditions through the exosystem and thereby exerts indirect influences on individual development (Bronfenbrenner & Morris, 2006). Alongside systematic shifts in social environments, educational policies, family structures, and interpersonal relationships, mainland-Chinese adolescents are embedded within this contemporary sociocultural context, which shapes their distinct psychological functioning and behavioural patterns. Therefore, examining the characteristics of social camouflaging among adolescents in Chinese mainland enables a systematic and comprehensive understanding of how sociocultural factors shape individuals' social behaviours. It also delivers new empirical evidence and research perspectives for studies on social camouflaging within collectivist cultures.

Therefore, the present study aims to validate the psychometric properties of the simplified CAT-Q-Ch among neurotypical adolescents in Chinese mainland and examine its applicability across the full

adolescent period, laying a foundation for subsequent relevant research. To accomplish these research goals, the present study performs the following analytical procedures: (1) validates the stability of the original three-factor structure (masking, compensation, and assimilation) and examines its measurement invariance across age and gender; (2) evaluates the questionnaire's internal consistency and test–retest reliability; (3) verifies the discriminant validity of the questionnaire through quantitative semantic analysis; and (4) explores the correlational relationships among social camouflaging, autistic traits, and coping styles.

Methods

Participants and Procedure

This study implemented two rounds of data collection. The first round, designed to explore and validate the questionnaire's latent factor structure, yielded 900 returned questionnaires. After rigorous screening based on built-in lie-detection items, 805 valid responses were retained, corresponding to an effective response rate of 89.44%. All valid data were randomly divided into two subsamples. The first subsample comprised 405 participants aged 11–23 years (190 females, age: $M = 16.51$, $SD = 3.29$) and was used for exploratory factor analysis (EFA). The second subsample included 400 participants (190 females; age: $M = 16.80$, $SD = 2.56$) and served for confirmatory factor analysis (CFA) and measurement invariance testing. The two subsamples showed no significant differences in terms of gender ($Z = -.167$, $p = .868 > .050$) and age ($t = -1.405$, $p = .160 > .050$, Cohen's $d = -.099$). The second round of data collection aimed to examine the reliability and validity of the questionnaire. A total of 297 questionnaires were collected. Participants who provided careless responses (those failing the lie-detection checks) were excluded, leaving a final valid sample of 269 participants aged 12–23 years (112 females, age: $M = 17.04$ years, $SD = 2.81$).

Data were collected via questionnaire surveys. A random sampling method was adopted to survey students enrolled in junior high schools, senior high schools and universities across Chinese mainland. Questionnaires were distributed using the online platform, and participants completed the surveys on computers or mobile phones. This study was approved by the Psychology and Education Research Ethics Committee of Minnan Normal University (approval code No. 2026-09-02). Teachers relayed the detailed information about this study to parents on behalf of the research team. Written informed consent was obtained from parents or legal guardians for minor participants, and verbal assent was obtained from minor students prior to study enrolment. For participants aged 18 years or older, written informed consent was collected directly from the participants themselves.

Measurements

The Simplified Chinese Version CAT-Q (CAT-Q-Ch)

The CAT-Q is an instrument developed and validated by Hull et al. (Hull et al., 2019). Authorization for the Chinese translation of the CAT-Q scale was granted by the original authors to another researcher in Taiwan, China. The resulting traditional CAT-Q-Ch was back-translated into English by an independent translator; the back-translation was then reviewed and formally approved by the original CAT-Q developers (Liu et al., 2024). Our research team obtained permission to adapt and use this questionnaire from the developers of the traditional CAT-Q-Ch. Following the conversion of the traditional Chinese into simplified Chinese, the cross-regional applicability of all items for administration in Chinese mainland was discussed and verified by psychologists and experts specializing in autism research. In addition, appropriate wording revisions were carried out on the simplified Chinese items by a Taiwan-based researcher, with optimal semantic and interpretive consistency preserved between the two Chinese language variants.

The simplified CAT-Q-Ch consists of 25 items loading onto three predefined subscales: Masking (8 items), Compensation (9 items), and Assimilation (8 items). A 7-point Likert response scale was adopted for the questionnaire, ranging from 1 = Strongly Disagree to 7 = Strongly Agree. Higher total scores indicate greater self-perceived camouflaging behaviors exhibited by individuals in interpersonal settings.

Broad Autism Phenotype Questionnaire (BAPQ)

This self-report questionnaire is designed to assess the level of autistic traits in individuals (Hurley et al., 2007). It contains 36 items distributed across three subscales, each consisting of 12 items: Aloof, Pragmatic Language, and Rigid. The operational definitions of the three dimensions are as follows: Aloof refers to a lack of interest in or inability to derive pleasure from social interactions; Pragmatic Language denotes difficulties in the pragmatic use of language, which hinder effective communication and the maintenance of fluid, interactive conversations; Rigid describes stereotyped behaviors, lack of interest in changes, or poor adaptability to alterations. A 6-point Likert rating scale was adopted, with response options ranging from 1 = Rarely to 6 = Often. Subscale scores were computed by summing the scores of corresponding items, and the total score across three subscales represents the overall level of an individual's autistic traits. The Chinese version of this questionnaire has been verified to be applicable for Chinese participants (Qian et al., 2014). In the present study, the Cronbach's α coefficients for the full scale and its three dimensions were .85 (total scale), .80 (Aloof), .76 (Pragmatic Language), and .54 (Rigid), respectively.

Simplified Coping Style Questionnaire (SCSQ)

This questionnaire comprises 20 items and is developed to evaluate diverse attitudes and strategies individuals employ when coping with daily life stressors (Xie, 1998). A 4-point Likert scoring system is applied, with response anchors ranging from 0 = Not adopted at all to 3 = Frequently adopted. The scale is divided into two subscales: positive coping and negative coping. The positive coping subscale consists of Items 1 to 12, with a sample item being "Try to look on the bright side of things". The negative coping subscale includes Items 13 to 20, exemplified by the item "Try to take a break or vacation to set aside problems (worries) temporarily". Subscale scores are calculated by summing the

scores of relevant items. In the current study, the Cronbach's α coefficients for the overall scale and its two dimensions were .86 (total scale), .87 (positive coping), and .74 (negative coping), respectively.

Statistical analysis

Pearson correlation analysis, EFA as well as reliability and validity tests were performed by SPSS 25.0, while Mplus 7.4 was adopted for CFA and measurement invariance testing. In the EFA, items were sequentially removed to obtain a parsimonious and stable factor-structure according to the following criteria: (1) factor loadings below .40 on their intended factor; (2) cross-loadings above .40 on two or more factors; (3) items with insufficient representation of the core content of their target dimension or ambiguous conceptual consistency with the corresponding subscale (Zhang & Xiao, 2019).

Measurement invariance was assessed by comparing a set of hierarchically nested models to establish four successive levels of cross-group invariance (Sass, 2011). Configural invariance tests whether the overall factor structure holds identically across subgroups; metric invariance (weak invariance) constrains factor loadings to be equal across groups; scalar invariance (strong invariance) imposes equality constraints on the intercepts of observed variables; and strict invariance (error variance invariance) further restricts residual error variances to be invariant across groups. For measurement invariance evaluation, models were estimated using mean-adjusted maximum-likelihood estimation (MLM). Following Cheung and Rensvold (2002), the scale was considered to demonstrate equivalent factor meaning and structure across subgroups if $\Delta CFI \leq .01$ and $\Delta RMSEA \leq .015$.

In reliability analysis, Cronbach's α was used to evaluate internal consistency, while test-retest reliability was estimated using single-measurement, absolute-agreement, two-way mixed-effects intraclass correlation coefficients (ICCs). Test-retest reliability was assessed among participants who completed the questionnaire a second time, with a 4-week interval between the initial and follow-up assessments. Following Koo and Li (2016), ICC values were interpreted as follows: moderate reliability (0.50–0.75), good reliability (0.75–0.90), and excellent reliability (> 0.90).

In addition, several items of the CAT-Q share notable similarities with those from scales measuring social anxiety or autistic traits (e.g., "I constantly think about the impression I make on others" or "In social situations, I try my best to avoid interacting with other people") (Fombonne, 2020). Given that numerous studies on social camouflaging focus on the associations between camouflaging behaviors and emotional as well as personality traits, it is necessary to ensure that the CAT-Q possesses adequate discriminant validity from relevant measurement instruments (Piccirillo et al., 2016). Accordingly, quantitative semantic analysis was adopted in the present study, and computed cosine similarity across item text to quantify the degree of item overlap between the simplified CAT-Q-Ch and other related scales (Rosenbusch et al., 2020).

Results

Exploratory Factor Analysis

Principal axis factoring was adopted for factor extraction, with the eigenvalue threshold set above 1.00 and the maximum iteration number fixed at 25. Direct Oblimin oblique rotation was further performed for factor rotation. The initial EFA extracted six factors with eigenvalues greater than 1.00, collectively explaining 61.16% of the total variance. However, the corresponding item loadings demonstrated unsatisfactory convergent properties and deviated notably from the original scale's theoretical construct. Combined with the scree plot, which showed an obvious inflection point starting from the third factor (see Fig. 1), the factor number was therefore constrained to three, and the exploratory factor analysis was re-performed.

Following the sequential removal of items with factor loadings below .40 and problematic cross-loading items (Q12, Q18, Q24, Q1, Q8), the item loadings for the five deleted items are presented in Supplementary Table S1, EFA was re-performed on the remaining 20 items. The Kaiser–Meyer–Olkin (KMO) value was .91, and Bartlett's test of sphericity was significant ($\chi^2 = 3403.47$, $df = 190$, $p < .001$), confirming the suitability of the dataset for factor analysis. The three extracted factors all had eigenvalues greater than 1.00 (6.93, 2.66, and 1.27), accounting for a cumulative variance of 54.30%. The item loading pattern closely aligned with the original scale's theoretical structure. Accordingly, the original three-factor labels were retained in the present study. Factor loadings of all retained items are displayed in Table 1.

Confirmatory Factor Analysis

CFA was performed to cross-validate the three-factor structure extracted from EFA, with the hypothesized measurement model presented in Fig. 2. The model yielded acceptable goodness-of-fit indices: $\chi^2 = 292.79$, $\chi^2/df = 1.81$, CFI = 0.946, TLI = 0.937, SRMR = 0.066, RMSEA = 0.045, AIC = 27822.76, and BIC = 28094.18. These results collectively indicate that the revised simplified CAT-Q-Ch exhibits adequate construct validity.

Table 1
The Factor Loadings of the Final Explanatory Factor Analysis

Item	Masking	Compensation	Assimilation
Q6. I adjust my body language or facial expressions so that I appear interested by the person I am interacting with	.813	.029	– .059
Q15. I monitor my body language or facial expressions so that I appear interested by the person I am interacting with	.717	.156	– .018
Q2. I monitor my body language or facial expressions so that I appear relaxed	.653	.055	.016
Q9. I always think about the impression I make on other people	.604	– .156	.098
Q21. I adjust my body language or facial expressions so that I appear relaxed	.572	.283	– .081
Q23. I have spent time learning social skills from television shows and films, and try to use these in my interactions	– .063	.794	– .081
Q20. I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction	.025	.731	– .062
Q17. I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills	– .076	.665	.022
Q14. I have tried to improve my understanding of social skills by watching other people	.258	.451	.056
Q4. I have developed a script to follow in social situations (for example, a list of questions or topics of conversation)	.135	.437	.189
Q11. I practice my facial expressions and body language to make sure they look natural	.243	.433	.195
Q5. I will repeat phrases that I have heard others say in the exact same way that I first heard them	.207	.422	.260
Q19. I feel free to be myself when I am with other people (Reversed)	– .058	– .014	.702
Q22. When talking to other people, I feel like the conversation flows naturally (Reversed)	– .128	.003	.687
Q16. When in social situations, I try to find ways to avoid interacting with others	.094	.123	.627
Q25. In social situations, I feel like I am pretending to be 'normal'	.227	.040	.616

Item	Masking	Compensation	Assimilation
Q7. In social situations, I feel like I'm 'performing' rather than being myself	.216	.112	.582
Q13. I have to force myself to interact with people when I am in social situations	.157	.102	.533
Q10. I need the support of other people in order to socialise	.168	.167	.425
Q3. I rarely feel the need to put on an act in order to get through a social situation (Reversed)	– .089	– .162	.412

Measurement invariance

Multiple-group CFA was conducted to examine the measurement invariance of the revised simplified CAT-Q-Ch across gender and age groups. Participants were divided into three developmental stages: middle adolescence (11–15 years), late adolescence (16–18 years), and emerging adulthood (19–23 years) (Steinberg, 2022). As summarized in Table 2, the nested models showed no significant declines in model fit. These findings confirmed that the simplified CAT-Q-Ch possesses invariant item interpretations and latent factor structures across male and female participants, as well as across the three age subgroups.

Table 2
Measurement invariance tests of the simplified CAT-Q-Ch across gender and age group

Model	χ^2	$\Delta\chi^2$	df	RMSEA	90% CI of RMSEA	CFI	Model Comparison	Δ CFI	Δ RMSEA
Gender									
M1	460.40	—	321	.047	(.037, .056)	.946			
M2	483.47	23.07	338	.046	(.037, .055)	.943	M2 vs M1	– .003	– .001
M3	508.98	25.51	355	.047	(.037, .055)	.940	M3 vs M2	– .003	.001
M4	547.93	38.95	380	.048	(.039, .056)	.933	M4 vs M3	– .007	.001
Age group									
M1	683.49	—	481	.056	(.046, .066)	.925			
M2	716.71	33.22	512	.055	(.045, .064)	.924	M2 vs M1	– .001	– .001
M3	759.64	42.93	542	.054	(.044, .066)	.922	M3 vs M2	– .002	– .001
M4	809.75	50.11	588	.057	(.047, .069)	.919	M4 vs M3	– .003	.003
Note: M1 = Configural invariance model; M2 = Weak invariance model; M3 = Strong invariance model; M4 = Strict invariance model; df = Degrees of freedom; CFI = Comparative fit index; RMSEA = Root mean square error of approximation; CI = Confidence interval.									

Quantitative semantic analysis

Quantitative semantic analysis was performed using the online tool developed by Rosenbusch et al. (2020) to evaluate the unique validity of the simplified CAT-Q-Ch. Given that the tool only supports English scale items, the revised CAT-Q-Ch items were back-translated into English and subsequently imported into the analysis platform. The semantic similarity results are illustrated in Fig. 3. The five scales with the highest semantic similarity to the simplified CAT-Q-Ch included the Possibility of Interaction, Negative Self-Description, Collective Self-Esteem, Competence Satisfaction, and Online Peer Victimization, with similarity coefficients ranging from .44 to .53. These moderate similarity coefficients suggest partial textual overlap between CAT-Q-Ch and these external scales, reinforcing the need for further empirical assessment of discriminant validity.

Reliability

The simplified CAT-Q-Ch exhibited satisfactory internal consistency, with Cronbach's α values of .867 for the total scale, as well as in the masking subscale ($\alpha = .779$), compensation subscale ($\alpha = .798$) and assimilation subscale ($\alpha = .813$). Meanwhile, the scale demonstrated excellent test–retest reliability. The total score yielded strong temporal stability ($r = .899, p < .001$; $ICC = 0.899, p < .001$). Similarly, the three subscales also achieved favorable test–retest reliability: masking ($r = .811, p < .001$; $ICC = 0.810, p < .001$), compensation ($r = .815, p < .001$; $ICC = 0.795, p < .001$), and assimilation ($r = .822, p < .001$; $ICC = 0.799, p < .001$).

Criterion-Related Validity

The criterion-related validity results are displayed in Table 3. The total social camouflaging score and its three subscales were significantly and positively intercorrelated (all $ps < .001$). The overall simplified CAT-Q-Ch total score was positively associated with autistic traits and negative coping (all $ps < .001$) but showed no significant correlation with positive coping ($p = .246$). For subscale-level associations, masking correlated positively with autistic traits ($p = .026$) and negative coping ($p = .015$), with no significant linkage to positive coping ($p = .576$). Similarly, assimilation exhibited significant positive correlations with autistic traits and negative coping (all $ps < .001$), alongside a significant negative correlation with positive coping ($p < .001$). In contrast, the compensation subscale yielded non-significant associations with autistic traits ($p = .941$), positive coping ($p = .147$), and negative coping ($p = .107$).

Table 3
Correlation between social camouflaging and autistic traits and coping styles ($n = 269$)

1	1	2	3	4	5	6	7
CAT-Q-Ch total score	—						
2 Masking	.801 ^{***}	—					
3 Compensation	.737 ^{***}	.593 ^{***}	—				
4 Assimilation	.721 ^{***}	.315 ^{**}	.168 ^{**}	—			
5 Autistic traits	.388 ^{***}	.135 [*]	.050	.630 ^{***}	—		
6 Positive coping	– .068	.034	.089	– .224 ^{***}	– .304 ^{***}	—	
7 Negative coping	.219 ^{***}	.149 ^{**}	.098	.226 ^{***}	.167 ^{***}	.397 ^{***}	—
Note: * $p < .05$; ** $p < .01$; *** $p < .001$							

Discussion

This study revised the CAT-Q-Ch to examine social camouflaging behaviors among adolescents in Chinese mainland. The final simplified CAT-Q-Ch contains 20 items covering three subscales: masking, compensation, and assimilation. Consistent with the original English CAT-Q, all items of the assimilation subscale were fully retained, whereas three items from the masking subscale and two items from the compensation subscale were removed. The three-factor structure of the simplified CAT-Q-Ch yielded satisfactory construct validity and measurement invariance across gender and age groups. Additionally, the scale demonstrated adequate internal consistency and test–retest reliability. Correlation analyses indicated that the total score of social camouflaging, as well as the masking and assimilation subscales, were significantly positively associated with autistic traits, with the assimilation subscale showing the strongest correlation; the compensation subscale exhibited no such association. Furthermore, the total scale score and the two subscales (masking and assimilation) were positively correlated with negative coping styles, while the assimilation subscale was negatively correlated with positive coping styles.

The present study validated the factor structure of the simplified CAT-Q-Ch among neurotypical adolescents across a broad age range. To optimize the scale’s psychometric properties for this population, five items with subthreshold factor loadings were removed during scale revision. The first deleted item was Q12 (“I regard eye contact as unnecessary if I do not wish to make eye contact with others”), which assesses individuals’ attitudes toward eye contact in social interactions. For neurotypical individuals, eye contact serves as a default social norm that promotes interpersonal communication. In contrast, autistic individuals tend to avoid spontaneous eye contact and only use deliberate eye contact as a camouflaging strategy to appear neurotypical (Pierce et al., 2016; Schneid & Raz, 2020). Therefore, this item fails to reflect genuine camouflaging behaviors among neurotypical adolescents, accounting for its low factor loadings. The second set of excluded items included Q1 (“I deliberately mimic other people’s body language or facial expressions during interactions”) and Q8 (“I apply behaviors learned from observing others’ interactions to my own social encounters”). Both items belong to the compensation subscale and describe social skill acquisition through behavioral imitation, a pattern that is less salient among neurotypical youth. Neurotypical individuals can intuitively infer others’ mental states and prioritize interpersonal understanding during social exchanges. Autistic individuals, by contrast, struggle to connect social behaviors with underlying intentions and thus rely heavily on superficial imitation to achieve normative social performance (Hull et al., 2017). Accordingly, these two items exhibited low sensitivity in the present non-clinical adolescent sample. The final two eliminated items were Q18 (“I always know what impression I make on other people”) and Q24 (“I do not pay particular attention to what my face or body is doing during social interactions”). These items center on social self-monitoring, which involves the surveillance and regulation of one’s social behaviors. Prior factor analyses of the original CAT-Q have demonstrated distinct loading patterns on these items between autistic and typically developing groups, reflecting inherent differences in social experiences and cognitive processing (Hull et al., 2019; Liu et al., 2024).

The final three-factor structure identified in this study aligns with the original English CAT-Q, but differs from the two-factor structure reported in the traditional CAT-Q-Ch. Prior research proposed that the two-factor solution may stem from collectivistic cultural norms and social conformity pressure, which blur

the conceptual distinction between masking and compensation behaviors, alongside potential limitations of insufficient sample size (Liu et al., 2024). The present study's stable three-factor structure can be explained from three key perspectives. First, an adequately large sample facilitates the differentiation of distinct social camouflaging strategies. Individual differences in social camouflaging are closely linked to the level of autistic traits. Large sample sizes can better capture population variability in autistic-like characteristics, thereby enhancing the discriminative validity of different camouflaging dimensions. This interpretation is consistent with recent empirical evidence (Ai et al., 2024; Lundin Remnélius & Bölte, 2023). Second, dynamic developmental and social contextual changes during adolescence collectively shape individuals' social interaction patterns. Adolescence is marked by heightened self-awareness and increased interpersonal sensitivity. Widespread digital penetration further provides adolescents with abundant online social scenarios, motivating them to actively regulate self-presentation and deploy camouflaging strategies to establish favorable social impressions (Jedrzejewska & Dewey, 2022). Additionally, multi-layered social structural factors, including family background, regional environment, social class, and consumption patterns, contribute to the development of individual social competence (Huang et al., 2023; Li et al., 2024; Tang et al., 2024). Heterogeneity in social competence further accounts for individual variability in adolescent social camouflaging behaviors (Scheerer et al., 2020). Third, the connotations and functions of masking and compensation differ substantially between neurotypical and autistic populations. In the present non-clinical adolescent sample, masking and assimilation were significantly associated with autistic traits and maladaptive coping, while the compensation dimension showed no significant correlations with either variable. Specifically, masking reflects an internal regulatory process through which individuals perceive their autistic-like characteristics and actively conceal associated social deficits. In contrast, assimilation involves external behavioral adjustments to conform to the social norms of neurotypical peers (Radulski, 2022). Both dimensions are directly or indirectly influenced by autistic traits. However, compensation may serve as a general social skill-learning strategy for individuals with limited social experience, rather than a targeted adjustment for autistic traits related social difficulties (Livingston et al., 2020). Given the absence of a clinical sample in this study, this theoretical interpretation requires further verification in comparative studies involving autistic populations.

The psychometric performance of the CAT-Q is susceptible to age and gender differences. Prior studies have identified a nonlinear association between age and social camouflaging, highlighting the necessity of verifying measurement structural stability across broad age ranges (Jedrzejewska & Dewey, 2022). The model supported strict measurement invariance across gender and age subgroups according to ΔCFI and $\Delta RMSEA$ criteria. It should be noted that strict residual invariance is a highly stringent benchmark in psychometric practice; scalar invariance is generally sufficient for latent-mean comparisons across groups. Accordingly, the present study establish measurement invariance for the simplified CAT-Q-Ch across adolescent age and gender subgroups, which indicates that the scale can consistently measure social camouflaging behaviors across different developmental stages and gender, and aligns with existing empirical findings (Hull et al., 2019; van der Putten et al., 2023). Regarding reliability, although the current coefficients were marginally lower than those of the traditional CAT-Q-Ch,

the revised scale still demonstrated satisfactory internal consistency and test–retest reliability at both the total and subscale levels. The large sample size and wide age distribution of this study further strengthen the credibility and generalizability of the scale’s reliability.

Scholars have argued that high semantic similarity between newly developed and existing scales implies potential overlap in their measured psychological constructs, which hinders valid interpretation of correlational relationships among variables, such as impression management, self-monitoring, social anxiety and mental health, etc (Ai et al., 2022; Williams, 2022). To obtain empirical evidence for the discriminant validity, beyond the results of quantitative semantic analysis, we also found weak correlations between masking, compensation and self-monitoring in an extra small sample of emerging adults (see Supplementary Material S2 for more detail), which indicates satisfactory discriminant validity for the simplified CAT-Q-Ch. According to item characteristics, social camouflaging mainly serves to reduce perceived social shortcomings and prevent negative interpersonal evaluation, leading to effects comparable to self-monitoring.. However, self-monitoring focuses merely on modifying overt inappropriate behaviors, which do not necessarily stem from deficient social competence among typically developing individuals. In contrast, the unique nature of social camouflaging lies specifically in its targeted regulation of social difficulties originating from inadequate social competence (Scheerer et al., 2020). Notably, moderate similarity was found between the revised CAT-Q-Ch and other scales assessing individuals’ perceptions of self-competence and group states in social situations. This suggests that the questionnaire captures individuals’ self-awareness of social competence, social experiences, and situational social states. Hence, further evidence is needed to confirm the adequacy of its discriminant validity.

From a developmental perspective, adolescents exhibit heightened sensitivity to social cues and increased susceptibility to interpersonal influence, prompting them to adopt behaviors that conform to peer expectations (Albert et al., 2013; Blakemore & Mills, 2014; Burnett et al., 2009; Wagner et al., 2018). Faced with increasingly complex social contexts, adolescents tend to utilize diverse behavioral strategies to regulate self-presentation and adapt to social demands (Pledger, 1992). The current study found that the total score of social camouflaging, as well as masking and assimilation, were positively associated with negative coping. Additionally, assimilation was negatively correlated with positive coping. These results indicate that social camouflaging essentially represents a maladaptive behavioral pattern stemming from deficient social competence. Accumulating evidence has demonstrated that elevated social camouflaging is linked to greater anxiety, depression, perceived stress, suicide risk, and uncertainty, alongside lower life satisfaction and impaired self-awareness (Conde-Pumpido-Zubizarreta et al., 2026; Roisenberg et al., 2026; van der Putten et al., 2025). Therefore, exploring the distinct functions of different social camouflaging components can offer targeted insights for optimizing adolescents’ social adjustment, with valuable practical implications for promoting adolescent mental health development.

Limitations and Future Research

This study has several limitations that warrant consideration in future research. First, the factor structure and psychometric properties of the simplified CAT-Q-Ch require further validation in clinical samples. Item response patterns may vary across different populations. Specifically, items Q12, Q18, and Q24 consistently showed low factor loadings or undesirable cross-loadings across multiple revised CAT-Q versions, a finding replicated in the present study. This suggests limited discriminative validity for these items, which should be further revised and optimized by incorporating the unique social experiences of targeted populations and cross-cultural contextual characteristics. Moreover, for high-functioning autistic adolescents with normal intelligence, deficits in social competence substantially hinder school engagement, and frequent social camouflaging may adversely affect their physical and mental health. Examining the scale's measurement invariance across clinical and non-clinical subgroups can deepen our understanding of social camouflaging traits among autistic adolescents in Chinese mainland, which contributes to promoting their social inclusion and stable interpersonal relationship development.

Second, although the current sample spanned the full adolescent stage (including emerging adulthood), the sample size of early adolescents was relatively limited. Early adolescence is a critical developmental period characterized by drastic hormonal fluctuations and physical maturation, as well as gender-based differences in developmental pace. Hormonal changes reshape neural information processing, heighten adolescents' self-awareness and interpersonal sensitivity. Future studies should validate the psychometric robustness of the simplified CAT-Q-Ch among early adolescent samples to further verify its universal applicability across the entire adolescent period.

Third, the generalizability of findings derived from the quantitative semantic analysis requires further validation. Importantly, this semantic analysis tool only accepts English-language item text, and its underlying corpus remains under ongoing refinement. Consequently, evidence for construct uniqueness derived from this analysis is indirect and exploratory. While weak correlations between social camouflaging and self-monitoring were confirmed in our small-sample analysis (See Supplementary Material S2), it remains necessary to explore semantic overlap between the simplified CAT-Q-Ch and other scales under the Chinese cultural context.

Finally, this study did not explore the association between social camouflaging and mental health in typically developing adolescents. Social camouflaging serves as a maladaptive social coping strategy, and its negative psychological outcomes have been well documented in autistic populations. However, it remains unclear whether such adverse effects generalize to neurotypical adolescents and whether the predictive effects of different camouflaging subdimensions vary across developmental stages. Clarifying the distinct predictive roles of multifaceted social camouflaging behaviors on adolescent social adjustment can provide empirical support for developing targeted and precise intervention programs.

Conclusion

Overall, the revised simplified CAT-Q-Ch maintains the original three-factor structure and exhibits robust and satisfactory psychometric properties among neurotypical adolescents in Chinese mainland. This

validated scale can facilitate future research on social development in neurotypical adolescents, and support cross-age and cross-cultural comparative studies on social camouflaging.

Declarations

Ethics approval and consent to participate

This study was approved by the Psychology and Education Research Ethics Committee of Minnan Normal University (approval code No. 2026-09-02). Informed consent to participate was obtained from all of the participants, including written informed consent was obtained from parents or legal guardians for minor student.

Consent for publication

Not applicable.

Availability of data and materials

The data presented in this study are available on request from the first authors Shihuan Gao (shihuangao@mnnu.edu.cn)

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Shihuan Gao and Yanjie Su contributed to the study conception and design. The first draft of the manuscript was written by Shihuan Gao and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Figures

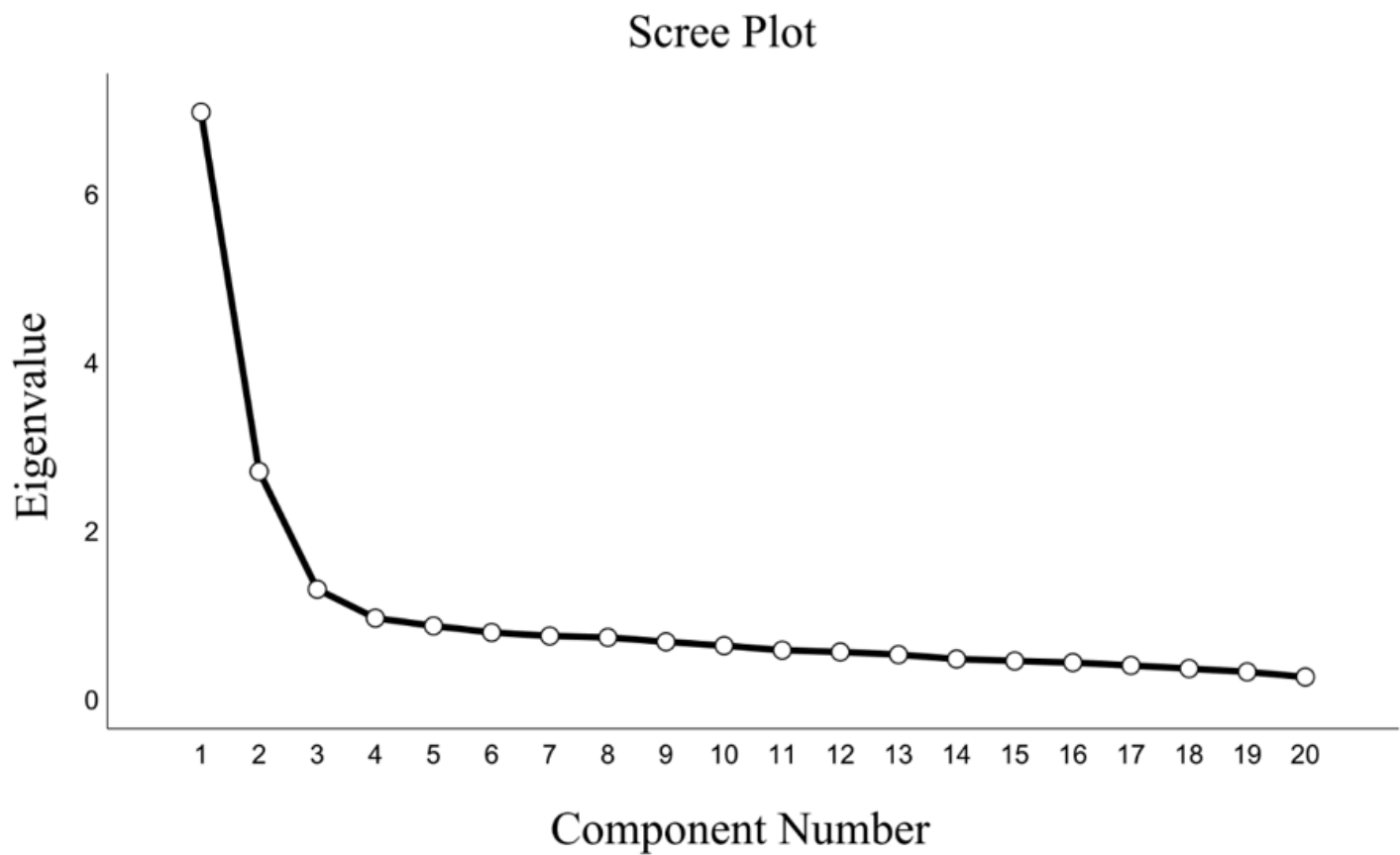


Figure 1

Scree plots for the simplified CAT-Q-Ch in the EFA

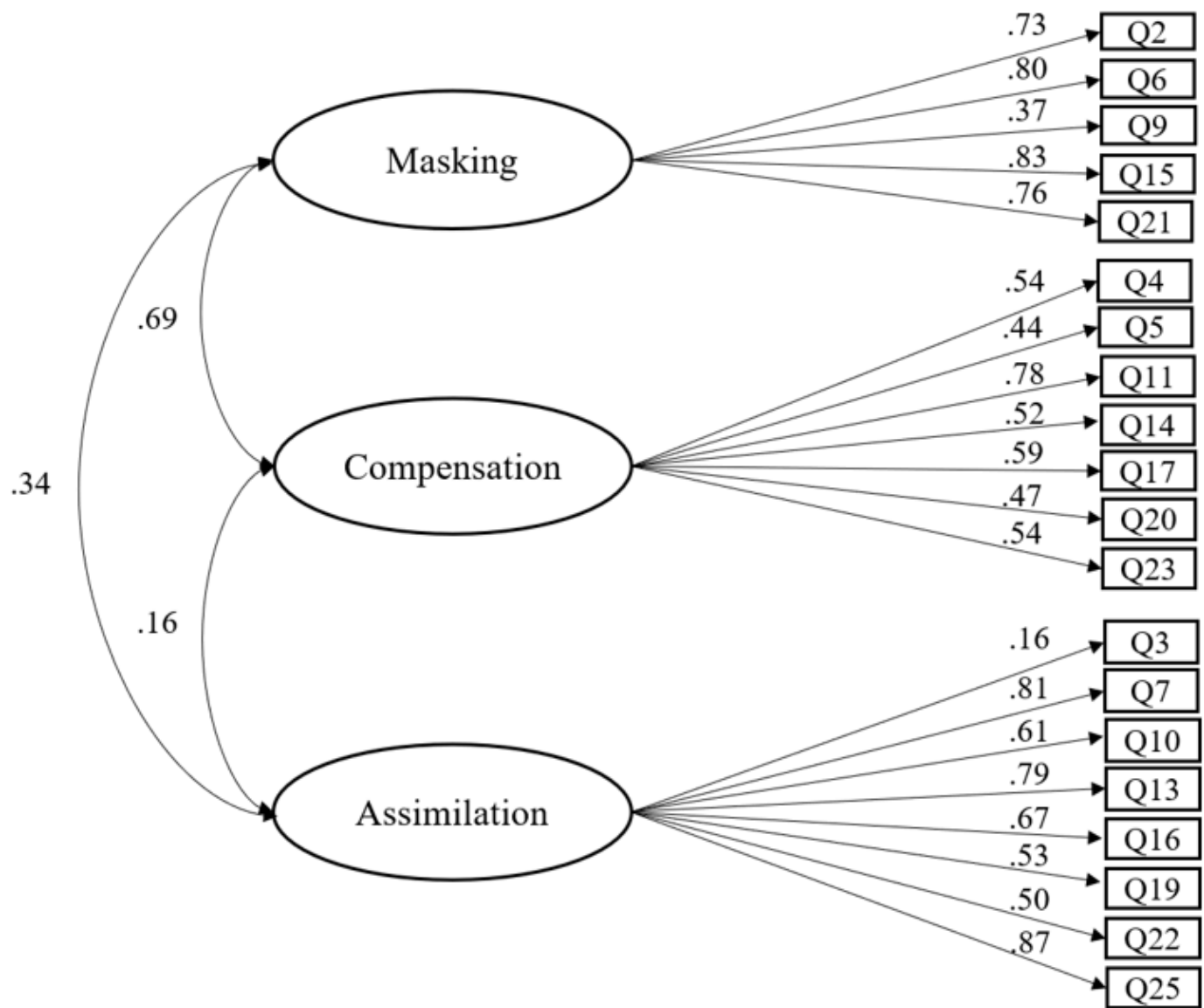


Figure 2

Three-factor structural model

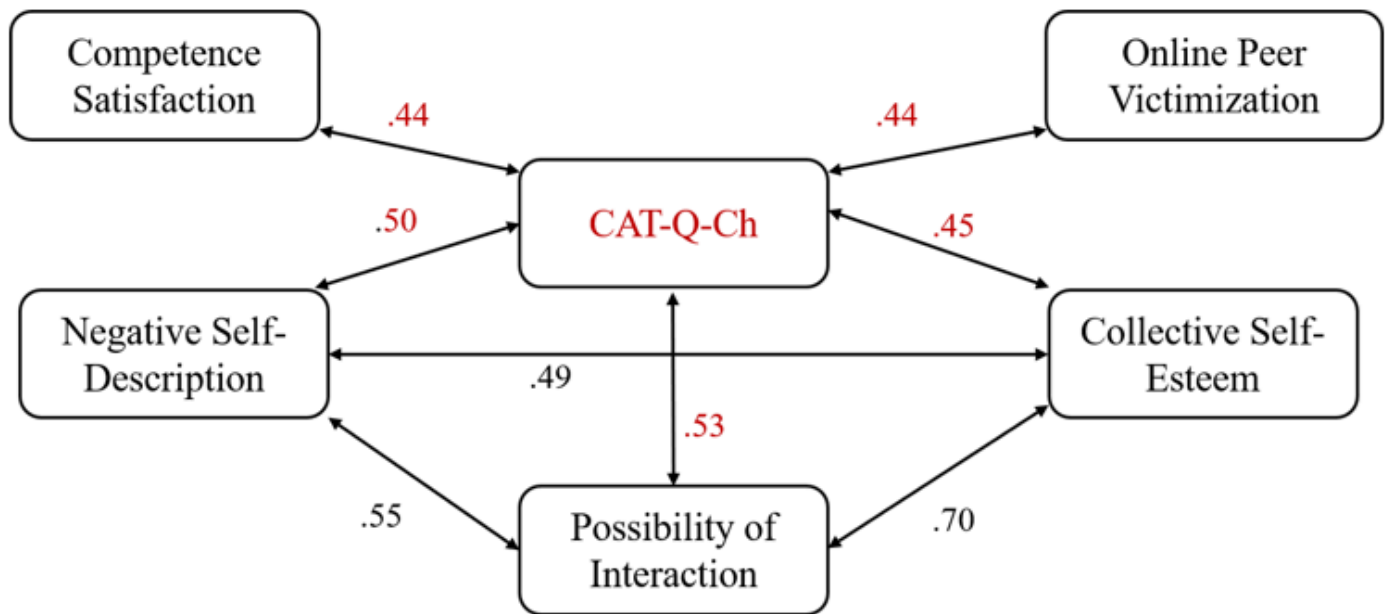


Figure 3

Quantitative semantic analysis of simplified CAT-Q-Ch

Supplementary Files

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- [SupplementaryMaterial.docx](#)