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The Relationship between Psychological Control-Behavioral Control and Anxiety: A Psychological Network Analysis Study

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Abstract

Adolescent anxiety disorders represent a significant public health challenge in China, wherein familial influences, particularly parental control, are pivotal. Prevailing research, however, often conceptualizes parental control monolithically, overlooking its multidimensionality and symptom-specific pathways. Bridging this gap, this study applied psychological network analysis (PNA) to delineate the nuanced associations between distinct parental control dimensions—parental psychological control (PPC) and parental behavioral control (PBC)—and specific generalized anxiety symptoms among Chinese vocational secondary school students (N = 3011). A cross-domain Gaussian Graphical Model, regularized with EBICglasso, revealed guilt induction (GI) as the central node within the control network and uncontrollable worry (GAD2) as the core anxiety symptom. A strong GI-GAD2 bridge edge highlighted a key mechanistic pathway. The network demonstrated high within-domain connectivity and distinct cross-domain associations: PPC dimensions showed positive links to anxiety, whereas PBC dimensions exhibited weaker or potentially buffering effects. The network proved highly stable (CS-correlation ≥ 0.70). These findings elucidate the intricate topology of parental control-anxiety interplays, pinpointing precise intervention targets—such as reducing guilt induction to mitigate uncontrollable worry. By shifting from aggregate-level correlations to a dynamic, symptom-oriented framework, this study provides a foundation for precision prevention and family-system interventions in adolescent mental health.

Subject Areas

Psychology

Keywords

Parental Control, Adolescent Anxiety, Psychological Network Analysis, Bridge Symptoms, Precision Intervention

1. Introduction

Adolescent anxiety disorders have become a salient public health concern in contemporary China. In recent years, youths have faced an increasingly heavy "psychological burden," with national trends indicating a sustained rise in anxiety and a particularly elevated risk among those aged 15 - 19 years [1]. Beyond a general sense of emotional distress, anxiety in adolescence exerts broad, system-level effects. At the academic and cognitive levels, anxious adolescents are more susceptible to interference from both threat-related and non-threat, task-irrelevant stimuli; deficits in attentional control and the over-allocation of limited cognitive resources to emotional information undermine learning efficiency and task performance [2] [3]. At the social level, heightened sensitivity to negative evaluation and avoidance of interpersonal situations impede the development of social skills and can constrain subsequent educational and vocational opportunities [4]. Importantly, anxiety is closely linked to dysregulation across neurobiological systems, co-occurs with depression, and has been associated with cardiovascular risk and alterations in immune functioning [5]-[7].

These adverse outcomes are not evenly distributed across families; patterns of family relationships and parenting practices shape heterogeneous risk trajectories. A growing body of evidence indicates that negative family climates and controlling parenting practices contribute to the onset and maintenance of adolescent anxiety [8] [9]. Accordingly, examining adolescent anxiety within its family context is not merely a practical recommendation but a theoretically and empirically warranted priority. Nevertheless, despite extensive work on associations between parental control and youth anxiety, parental control is a multidimensional construct whose distinct facets may exert differential—even opposing—effects on adolescents. Moreover, treating anxiety as a unitary outcome obscures symptom-level processes and the dynamic ways in which parental control may interface with specific anxiety manifestations. To address these gaps, the present study adopts a mechanism-focused approach using psychological network analysis to systematically investigate how dimensions of parental control are structurally and dynamically linked to discrete anxiety symptoms in adolescence.

2. The Relationship between Parental Control and Adolescent Anxiety

2.1. Conceptual Differentiation of Parental Control

Classic family-based research indicates that controlling parenting plays a pivotal role in the onset and maintenance of anxiety among children and adolescents [10]

[11]. Crucially, parental control is not a unitary construct. Barber's [12] two-dimensional model provides a clear framework to parse its heterogeneous effects. Psychological control (PPC)—characterized by guilt induction, love withdrawal, and other intrusions into the child's psychological autonomy—is widely regarded as intrusive and high-risk. Behavioral control (PBC)—manifested through rule-setting, supervision, and guidance—establishes predictable boundaries that can foster self-regulation when applied appropriately, yet both over- and under-control may be problematic.

2.2. Empirical Links Between Parental Control and Adolescent Anxiety

A substantial body of evidence documents robust associations between parental control and youth anxiety [13] (meta-analytic effect size $d = 0.58$). In a cross-sectional path analysis with 77 parent–child dyads, Affrunti and Woodruff-Borden [14] showed that overcontrol functions as a key component in a chain-mediating process culminating in child anxiety. Longitudinal work by Borelli *et al.* [15] further demonstrated that parental overcontrol prospectively predicts children's anxiety symptoms and emerges as a powerful influence independent of other family factors. In a community sample, Emerson *et al.* [16] reported a significant positive correlation between parental control and child anxiety ($r = 0.43$, $p < 0.001$). Over a three-year follow-up, Sun *et al.* [17] identified a bidirectional vicious cycle between parental psychological control and adolescent anxiety. Recent evidence also suggests that parents' negative beliefs about anxiety may mediate the link between overcontrol and adolescent anxiety [18]. Collectively, these findings converge in identifying parental control as a key predictor of youth anxiety while illuminating multiple explanatory pathways.

Despite these advances, many studies have treated parental control as a single variable, conflating PPC and PBC despite their distinct definitions and consequences. Context-sensitive analyses indicate that PPC (e.g., guilt induction) is more deleterious than PBC [19]. Converging neuroscientific evidence also points to differentiated neural pathways: PPC has been linked to aberrant activation in limbic regions and the prefrontal cortex [20] [21], whereas PBC has been associated with the striatum and sensorimotor cortices [22]. Treating "control" as a monolith obscures these mechanistic distinctions, preventing the identification of which specific components of control are most harmful and how their interactions map onto diverse anxiety profiles in adolescence.

Building on these gaps, some studies have begun to differentiate PPC and PBC and to document their distinct associations with anxiety [23]-[25]. However, this literature has rarely employed network-analytic approaches; as a result, the topology of relations between specific control dimensions and discrete anxiety symptoms remains unclear. Findings largely remain at the level of variable-to-variable associations and do not reveal the network structure linking parenting practices to symptom clusters. Consequently, the field lacks precision about the key bridges

between parental control and anxiety subcomponents—information that is essential for targeted intervention. Moreover, the dominant analytic toolkit (e.g., linear regression, structural equation modeling) is not optimized to uncover within-syndrome structure and bridge mechanisms among symptoms, limiting progress toward symptom-level, mechanism-informed interventions [26] [27].

2.3. From "Are They Related?" to "How Are They Connected?": Research Gaps and Methodological Innovations

Recent work has begun to distinguish between parental psychological control (PPC) and behavioral control (PBC), documenting heterogeneous associations with adolescent anxiety [23]-[25]. Yet this progress largely remains within a variable-centered paradigm: studies rarely provide a systematic characterization of fine-grained control dimensions, seldom decompose anxiety into discrete symptoms, and almost never model both domains within a single framework that captures their interactional architecture. In other words, we often know whether PPC/PBC correlates with anxiety, but not how specific control practices are connected to specific anxiety symptoms, whether a small set of bridge nodes sustains the overall network, or whether those bridges constitute actionable intervention targets. Although linear regression and structural equation modeling can estimate net effects and directional paths, they are not well suited to depict the interdependencies of complex systems, nor to detect cross-cluster bridges and self-sustaining dynamics that may emerge from such structures [26] [27].

Against this backdrop, Psychological Network Analysis (PNA) offers both theoretical and methodological advantages. PNA conceptualizes phenomena as networks of nodes (e.g., discrete anxiety symptoms and specific dimensions of parental control) connected by edges representing conditional associations after controlling for other variables—thereby yielding a structure that is closer to the underlying mechanisms of interaction [28] [29]. Departing from latent, segregated constructs, PNA situates parental control and anxiety within a single system to examine how particular edges weave together relatively distinct yet interdependent subnetworks, and to identify nodes that function as bridges maintaining network activation [30]. This shift enables a translation from the coarse goal of "reducing total scores" to an operational strategy of weakening high-weight edges and lowering the centrality of core or bridge nodes, thereby furnishing a principled basis for individualized and stratified, mechanism-informed interventions.

2.4. The Current Study

To address limitations of prior work—namely a predominant focus on single dimensions, relatively homogeneous samples, and variable-centered methods that preclude network-level inference—this study seeks to delineate the structural coupling between parental control and adolescent anxiety within a unified psychological network framework. Moving beyond total scores and single-path models, we conceptualize parental control at the construct level as comprising psycholog-

ical control (PPC) and behavioral control (PBC), which are further operationalized into fine-grained dimensions (e.g., guilt induction, love withdrawal [PPC]; monitoring/supervision, rule clarity, active solicitation [PBC]). At the symptom level, adolescent anxiety is decomposed into discrete symptom nodes (e.g., excessive worry, anticipatory fear, avoidance, tension, somatization). We estimate a cross-domain network (parental-control dimensions × anxiety symptoms) to recover conditional dependencies, identify high-weight edges, and detect core and bridge nodes, thereby revealing the specific control-symptom coupling mechanisms. Specifically, we address the following research questions (RQs):

RQ1. What are the global structural characteristics of the cross-domain network comprising parental-control dimensions and anxiety symptoms (e.g., edge density, subnetwork differentiation, global strength)?

RQ2. Which nodes exhibit high within-subnetwork centrality (e.g., strength centrality), and which nodes function as bridges connecting the parenting and anxiety subnetworks (bridge centrality)?

RQ3. Do PPC and PBC display systematically different network-level patterns, and do their constituent dimensions show heterogeneous links to anxiety symptoms (*i.e.*, high-risk vs. potentially protective/neutral connections)?

Correspondingly, we propose the following hypotheses (Hs):

H1 (Network level). Within the overall cross-domain network, PPC dimensions will show more salient positive conditional associations with anxiety symptoms than PBC dimensions, whereas PBC dimensions will show weaker or more mixed associations with anxiety symptoms. H2 (Dimension level—risk edges). Within PPC, guilt induction and love withdrawal will exhibit higher-weight cross-domain edges to core anxiety symptoms (excessive worry, anticipatory fear, avoidance).

H3 (Dimension level—protective/neutral edges). Within PBC, active solicitation and rule clarity will display weaker, and in some cases negative, edges with anxiety symptoms.

H4 (Bridge mechanisms). At least one to two bridge nodes will tightly connect the "control" and "anxiety" subnetworks; bridges are expected primarily along the guilt induction/love withdrawal → worry/avoidance pathways.

H5 (Robustness). The main edge directions and centrality rankings will show acceptable-to-good stability under bootstrap resampling. Theoretically, this work advances the field from static associations to dynamic structure, shifting attention from simple correlations between PPC/PBC and anxiety toward the evolving interaction patterns among specific control practices and specific symptoms. Methodologically, by employing Psychological Network Analysis (PNA), we model anxiety as an interconnected symptom system and quantify edge weights and core/bridge centrality, clarifying how practices such as love withdrawal preferentially activate particular symptoms and are linked to a broader pattern of interrelated symptoms—thereby illuminating individual differences. Practically, PNA supports precision prevention and intervention: it facilitates early identification and tiered support for adolescents exposed to adverse parenting contexts, and it

reorients intervention from reducing total scores to weakening high-weight edges and targeting core/bridge symptoms and specific control dimensions, improving efficiency and helping families disrupt the intergenerational perpetuation of anxiety.

3. Methods

3.1. Participants, Procedure, and Ethical Approval

Data were collected between April and May 2023 through a school-organized online survey administered on Credamo. Teachers from participating vocational secondary schools in Zhejiang Province distributed the Credamo questionnaire link to students in their classes. Eligibility was limited to students currently enrolled in Years 1 - 3 of vocational secondary schools. Students' school enrollment status was verified before link distribution by classroom teachers using school class rosters. Recruitment was therefore school-linked, but participation was voluntary: students completed the survey online through Credamo and could withdraw at any time without penalty. Because the questionnaire link was disseminated within classes, responses were collected in school/class contexts; however, school- and class-level identifiers were not retained in the analytic dataset, and the present network analyses were estimated at the individual-response level rather than as clustered or multilevel networks.

A total of 3100 students in the first to third year of vocational secondary schools from Zhejiang Province, China, were recruited for this study. We ensured the sample size was sufficient based on sample size estimation (see Supplementary Materials Result S1 for details). To ensure the accuracy and reliability of the data, strict exclusion criteria were applied, and participants who answered repeatedly via the same IP address or device were excluded. The final valid sample comprised 3011 students (25.84% male, 74.16% female) with an average age of 16.92 years ($SD = 0.89$). The number of respondents belonging to families with only one child was 1058, and the number of non-family only children was 1953. Of these, 2540 (84.30%) had parents in normal marriages, 281 (9.30%) were divorced, 177 (5.80%) had reconstituted their families, and 13 (0.40%) were others.

3.2. Measures

The Parental Psychological Control Questionnaire, the Parental Behavioral Control Questionnaire and the Generalized Anxiety Disorder Scale were used in this study. The full list of dimensions/items used in the psychological network analysis and the corresponding node codes are shown in **Supplementary** Table S1.

3.3. Parental Psychological Control (PPC)

To measure parental psychological control, this study used the Parental Psychological Control Questionnaire [31], which was developed by Barber in 1996 and validated and revised by Wang *et al.* [31] in the Chinese cultural context. The questionnaire consists of 18 items with good psychometric properties [32], in-

cluding Guilt-Inducing (GI; 10 items), Love Withdrawal (LW; 5 items), and Authority Assertion (AA; 3 items). Notably, the scale uses a 5-point Likert scale. Subjects rated statements between 1 (not at all consistent) and 5 (completely consistent), with higher scores indicating that the individual was under more severe parental psychological control. In the present study, the Cronbach's α for the scale was 0.96. The robust Cronbach's α confirms the internal consistency of the scale and supports its reliability in assessing parental psychological control.

3.4. Parental Behavioral Control (PBC)

Parental Behavioral Control was measured using the Parental Behavioral Control Questionnaire [31], which is a localized adaptation of Barber *et al.*'s [12] questionnaire. The questionnaire contains two dimensions of active questioning and behavioral constraints, and consists of 16 items (e.g., "My parents ask me to tell them about things that happen at school"), with each item scored on a 5-point Likert scale (1 = not at all consistent, 5 = completely consistent). Scores for all items were averaged, with higher composite scores indicating that individuals were more severely controlled by parental behavior. The questionnaire has good reliability and validity in Chinese populations [33] and is suitable for assessment in different background groups. In this study, the Cronbach's α of the scale was 0.95. The high Cronbach's α value indicates that the scale has strong internal consistency, which also highlights the reliability of the scale in measuring parental behavioral control.

3.5. Generalized Anxiety Disorder (GAD)

The present study used the Generalized Anxiety Scale to assess generalized anxiety symptoms. The scale was developed by [34], validated and revised by He *et al.* [35] in the context of Chinese medicine. The scale consists of 7 items and is rated on a 4-point scale (1 = not at all, 4 = almost every day), with higher scores indicating a higher risk of anxiety symptoms. The scale has good reliability and validity in the Chinese population [36] [37]. The scale exhibited excellent internal consistency in this study, as indicated by a Cronbach's α coefficient of 0.96.

3.6. Statistical Analyses

There are no missing values in the final data because the individual questionnaire items are set to be mandatory to answer. All statistical analyses were performed using R (version 4.3.3 in RStudio 2025.05.1 + 513). The analysis proceeded in three stages. First, common method bias was examined using the included data (see Supplementary Materials Result S2 for details). Second, descriptive and correlational analyses were performed on the selected variables (see Supplementary Materials for details). Finally, a psychological network analysis was conducted, incorporating both dimensional and item and domain mixed approaches. This final stage of analysis consisted of the following steps as following the workflow and reporting standards proposed by Burger *et al.* [38].

Network estimation

We estimated the network structure using the Gaussian Graphical Model [29] (GGM), a regularized partial correlation network. The networks were estimated from Pearson correlation matrices. Although the original PPC, PBC, and GAD indicators were Likert-type variables, the PPC and PBC nodes were dimension scores averaged across multiple 5-point items, and the GAD indicators had four ordered response categories. Following common practice in cross-sectional psychological network analysis, these variables were treated as approximately continuous. EBICglasso was appropriate for these data because it estimates a sparse Gaussian graphical model based on regularized partial correlations, retaining conditional associations that are more likely to be stable while shrinking trivial edges to zero. This approach was suitable given the large sample size (N = 3011), the exploratory aim of identifying interpretable conditional dependencies, and the need to reduce potentially spurious small edges in a network with multiple parenting and anxiety indicators. The regularization process employed the graphical least absolute shrinkage and selection operator [39] (glasso) with Extended Bayesian Information Criterion model selection (EBIC), referred to as the EBICglasso model. The tuning parameter was set to 0.50 based on the findings of Foygel & Drton [40]. Notably, both the expected dimensional and item and domain mixed were estimated via the EBICglasso model, facilitating the removal of negligible partial correlations from the networks.

Centrality indices calculation

To quantify the structural importance of each node in the network, the following centrality indices were estimated [41]: strength (sum of absolute edge weights connected to a node), closeness (inverse sum of shortest path lengths to all other nodes), and betweenness (frequency of a node being on the shortest paths between other node pairs). Following previous research [42] [43], we prioritized interpretation of strength, given its higher stability. In addition, we computed expected influence, which retains edge signs (positive or negative) and is more suitable for dynamic symptom network analyses. Betweenness and closeness centrality were examined but are considered less reliable in psychological networks and thus are reported in supplementary materials for completeness [41]. All indices were standardized (Z-scores) for comparative interpretation.

Accuracy and stability assessment

We assessed the accuracy and stability of the dimensional and item and domain mixed networks by using the R-package bootnet [29]. Our evaluation comprised three key aspects: Edge Weight Accuracy: We employed a nonparametric bootstrap approach (1000 bootstrap samples) to calculate 95% confidence intervals (CI) for edge weights. Narrower CIs indicate more accurate edge calculations. Edge Weight Bootstrapped Difference Tests: To determine whether two edge weights or two nodes' centrality indices significantly differ from each other, we performed bootstrapped difference tests (1000 bootstrap samples, $\alpha = 0.05$). Node Centrality Stability: The stability of node centrality was evaluated by the correlation stability (CS) coefficient, utilizing a case-dropping subset bootstrap approach (1000 boot-

strapped samples). A CS coefficient value not less than 0.25 is considered acceptable, with a preference for values exceeding 0.50, CS-coefficients ≥ 0.70 indicate excellent stability, meaning the centrality order of nodes remains reliable even when a substantial portion (up to 70%) of the sample is excluded [44].

Network visualization

Network graphs were visualized using the qgraph package [45]. In the domain network, nodes denoted dimensions of the measures, while in the item-dimensional mixed network, they represented dimensions of parental control and items measuring generalized anxiety. Edges conveyed partial correlations between nodes, adjusting for all others. Notably, edge width and color reflected correlation strength, with thicker edges indicating stronger correlations. The red-green color scheme denoted negative and positive correlations, respectively. The network layout, governed by Fruchterman & Reingold [46]'s algorithm, strategically positioned influential nodes centrally and clustered strongly connected nodes.

4. Results

4.1. Domain Network of GAD, PPC, and PBC

Domain Network

We conducted a regularization network using all dimensions of parental control and generalized anxiety, and the resulting domain network is depicted in **Figure 1**. Several notable characteristics are evident in this network. First, out of the 15 possible edges (calculated as 6*(6 – 1)/2), 14 (93.33%) did not have zero values, and most displayed positive values. Second, the network revealed four edges with the most robust regularized partial correlations: between GI and LW (weight = 0.69), IS and BR (weight = 0.63), between GI and AA (weight = 0.38).

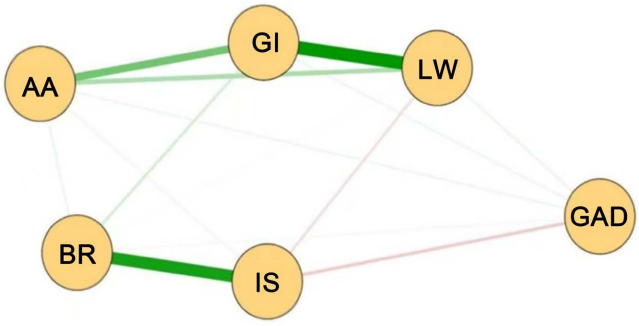

Figure 1. Dimension network structure diagram. GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GAD = Generalized Anxiety Disorder. Nodes are labelled circles; green lines denote positive correlations; red lines denote negative correlations. Thicker lines indicate higher correlation coefficients.

4.2. Centrality Indices

Centrality indices for all dimensions of parental control and generalized anxiety were illustrated in **Figure 2**. Considering the index of strength and expected in-

fluence, dimension GI had the highest strength centrality. It is worth noting that a variable in the psychological network scored highest on Strength and Expected Influence (EI), indicating that it is a core variable in the network. Furthermore, the results of the closeness and betweenness were presented in the supplemental materials for readers with a keen interest (refer to Figure S1).

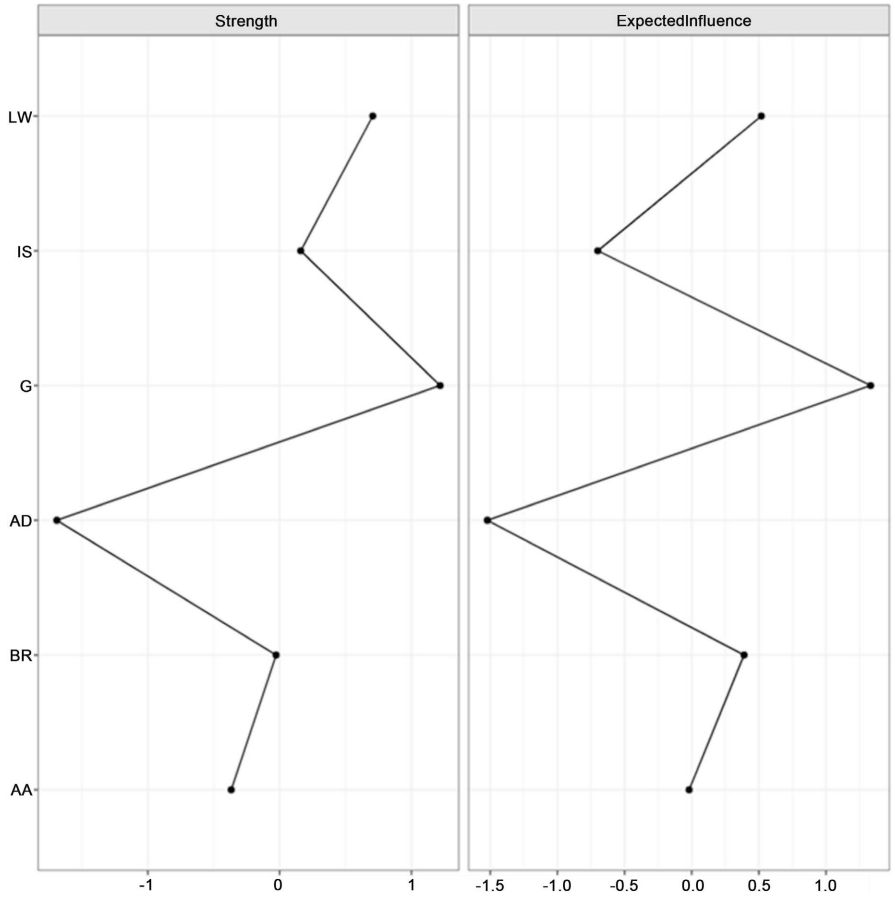

Figure 2. Centrality diagram of parental control and anxiety dimensions. GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GAD = Generalized Anxiety Disorder.

4.3. Accuracy and Stability

To assess the reliability and robustness of the estimated network model, we conducted 1000 non-parametric bootstrap resampling analyses using the bootnet package. As shown in Figure 3, the confidence intervals for most edges in the network were relatively narrow, indicating that the edge weight estimates are precise and stable. Furthermore, to evaluate the robustness of the centrality indices, we performed case-dropping bootstrap stability analysis on Strength and Expected Influence. The results showed that both Strength and Expected Influence have correlation stability coefficients (CS-coefficients) of at least 0.70 (as detailed in Figure 4), which is well above the recommended acceptable lower limit of 0.25 and the ideal threshold of 0.50 [29]. This finding indicates that even when up to

70% of the sample is dropped, the average correlation with the original sample remains approximately 1.0, demonstrating that the centrality indices are highly consistent and exhibit excellent stability and interpretability.

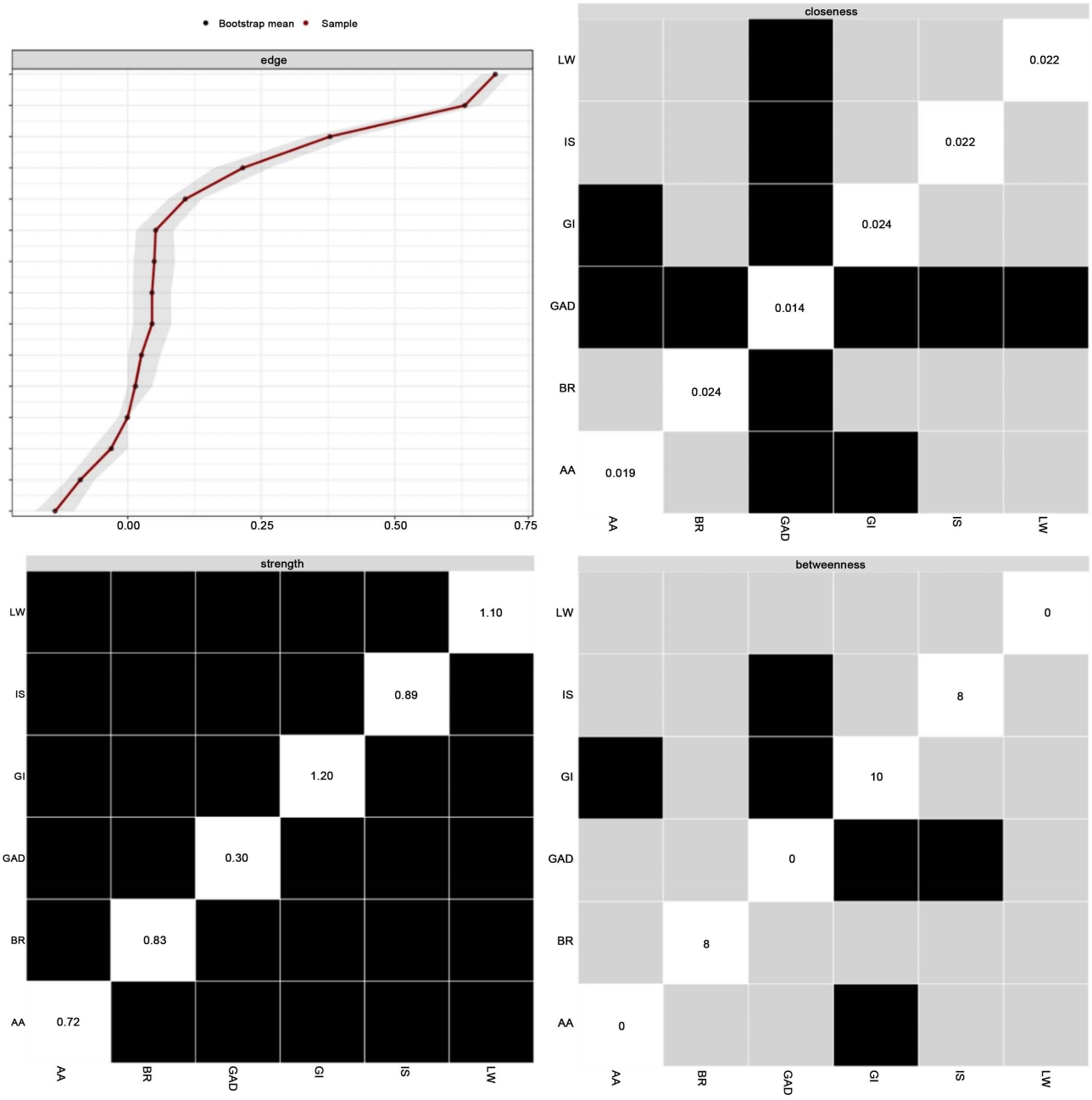

Figure 3. Centrality accuracy diagram for parental control and anxiety dimensions. The grey shaded areas denote confidence intervals or data fluctuation ranges, whilst the grid matrix presents discrete data distributions. GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GAD = Generalized Anxiety Disorder.

4.4. Item and Domain Mixed Network of GAD, PPC, and PBC

Domain and Item mixed Network

We conducted a regularization network using the five dimensions of parental

psychological control measure and parental behavioral control measure, and seven factors of generalised anxiety measure, and the resulting domain network is depicted in Figure 5.

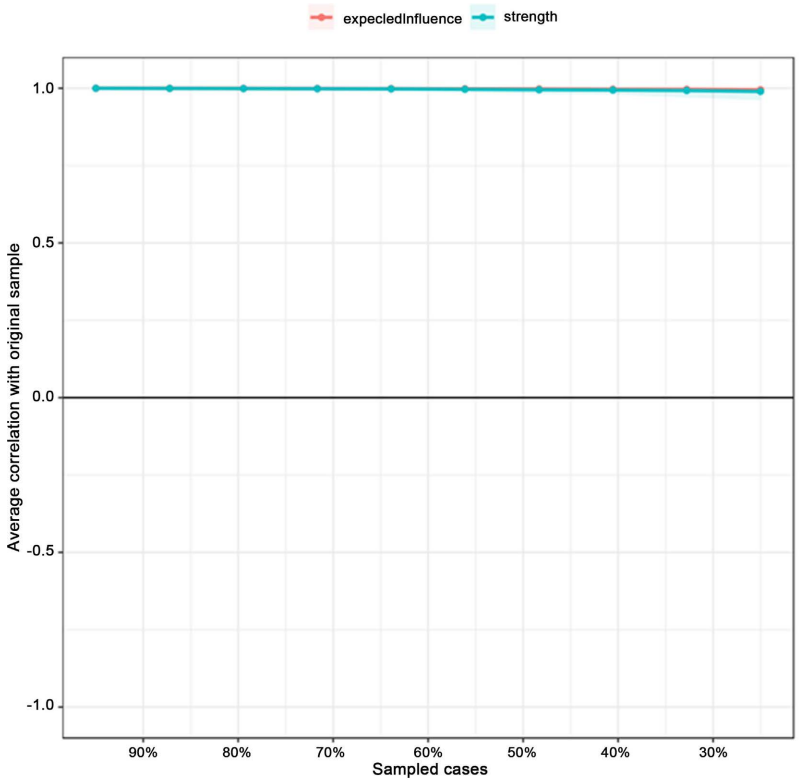

Figure 4. Stability diagram of centrality metrics for parental control and anxiety dimensions. Light red and light blue shading indicate data fluctuation ranges. The horizontal axis represents sampling proportion, decreasing from 100% to 0%. The vertical axis denotes correlation coefficients relative to the original sample, ranging from −1 to 1.

The network generated 66 possible edges (calculated as 12*(12 – 1)/2), among which 42 (63.6%) edges did not have zero values. Moreover, the network revealed six edges with the most robust regularized partial correlations: All from the within-scale dimensions, existing between GI and LW (weight = 0.68), between IS and BR (weight = 0.63), between GAD1 and GAD2 (weight = 0.49), between GAD2 and GAD3 (weight = 0.42), between GI and AA (weight = 0.38), between GAD4 and GA5 (weight = 0.37).

4.5. Centrality Indices

The centrality indices for all dimensions of parental control and all items of generalized anxiety are illustrated in Figure 6. Analysis of the two primary indices, Strength and Expected Influence, revealed distinct patterns among the variables. Specifically, the dimension GI and the symptom GAD2 exhibited the highest strength centrality, indicating their central role within the network. More notably, these two variables (GI and GAD2) also scored highest on Expected Influence,

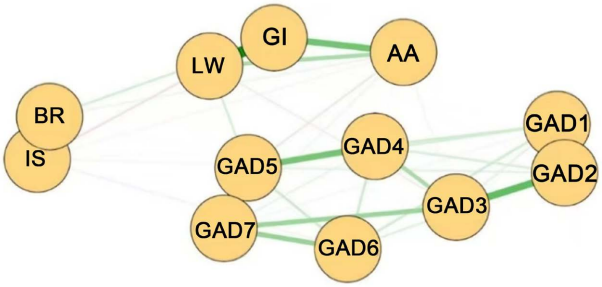

Figure 5. Network structure diagram of parental control dimensions and anxiety items. GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restricting = Generalized Anxiety Disorder Scale Item n. Nodes are labelled circles; green lines denote positive correlations; red lines denote negative correlations. Thicker lines indicate higher correlation coefficients.

confirming their role as the central and most pivotal nodes in the psychological network. This dual prominence indicates that GI and GAD2 are not only strongly connected to other nodes but also exert a disproportionate influence on the overall pattern of associations, potentially acting as key leverage points for clinical intervention. For readers with a keen interest, the results of additional centrality measures, namely closeness and betweenness, are available in the supplemental materials (refer to **Figure S2**).

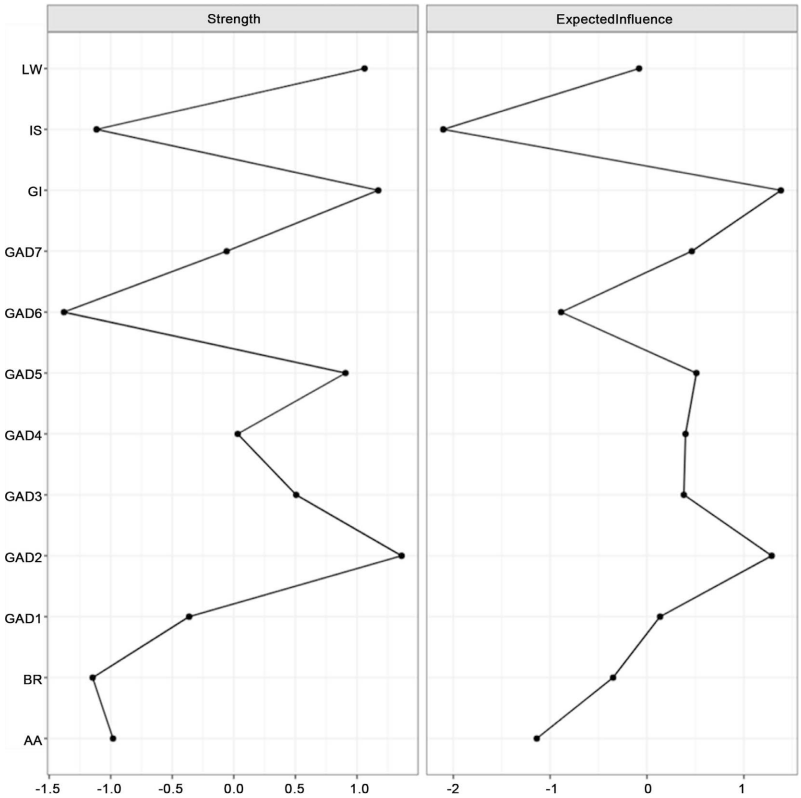

Figure 6. Centrality diagram of parental control and anxiety dimensions. GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GADn = Generalised Anxiety Disorder Scale Item n.

4.6. Domain Network Accuracy and Stability

To assess the reliability and robustness of the estimated network model, we conducted 1000 non-parametric bootstrap resampling analyses using the bootnet package. As shown in the network visualization Figure 7, the network structure exhibits a dense concentration of connections in the upper-right region with a gradual decrease toward the lower-left, indicating a complex but interpretable

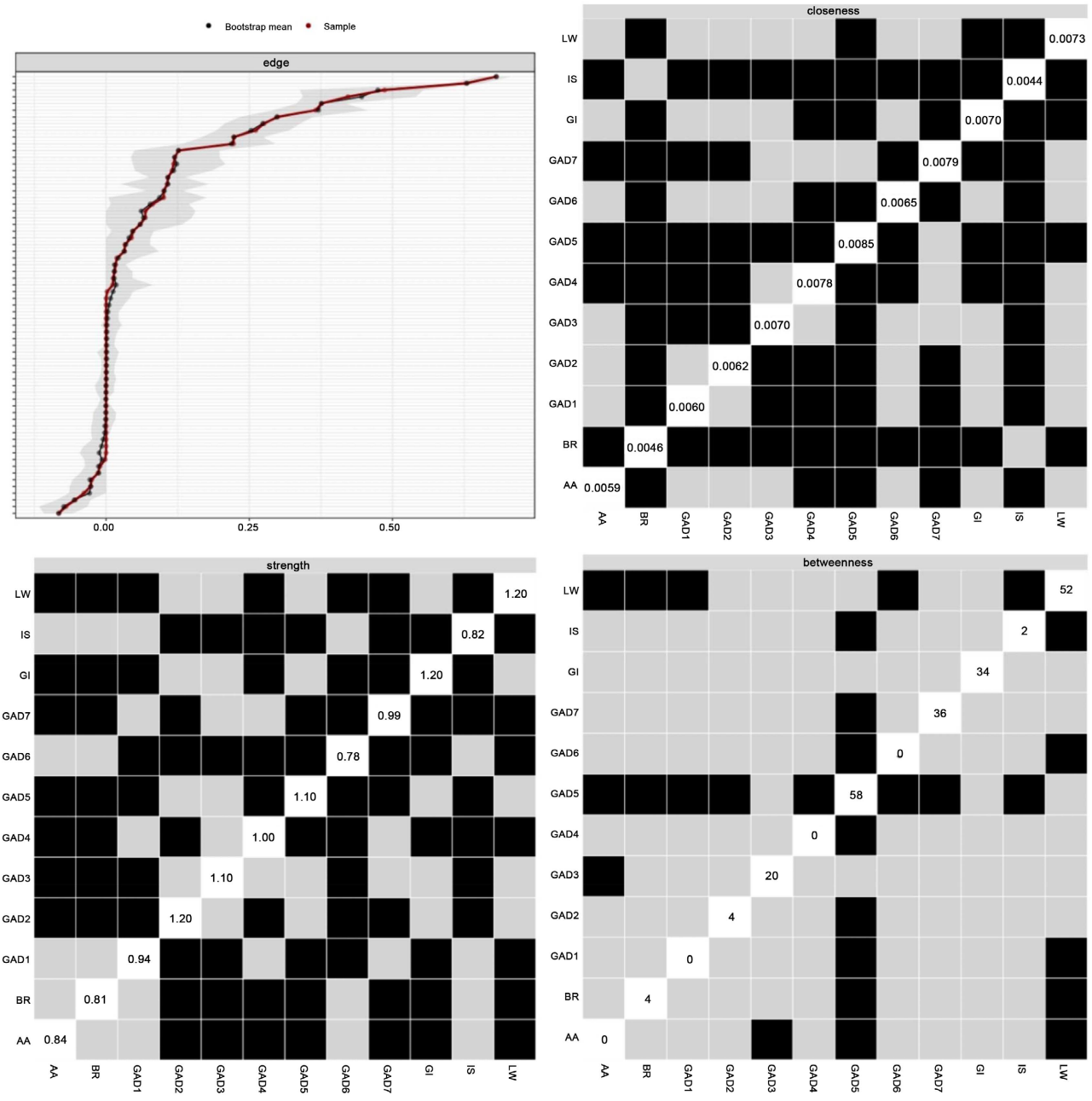

Figure 7. Accuracy diagram of centrality indices for parental control dimensions and anxiety items. The grey shaded areas denote confidence intervals or data fluctuation ranges, whilst the grid matrix presents discrete data distributions. GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GADn = Generalised Anxiety Disorder Scale Item n.

model. Although confidence intervals for edges are not directly visible in this visualization, prior analyses suggested that the edge weight estimates are precise and stable. Furthermore, to evaluate the robustness of the centrality indices, we performed case-dropping bootstrap stability analysis on Strength and Expected Influence. As detailed in the line plot (in **Figure 8**), the average correlation with the original sample for both indices remained high as the sample size decreased. Specifically, at 30% sampled cases (corresponding to 70% of the sample dropped), the average correlation for strength was approximately 0.85, and for expected influence it was slightly higher (around 0.85 or above). These correlation values are well above the recommended acceptable lower limit of 0.25 and the ideal threshold of 0.50 [29]. This finding indicates that even when up to 70% of the sample is dropped, the centrality indices remain highly consistent with the original results, demonstrating excellent stability and interpretability (See Result S1 and Result S2).

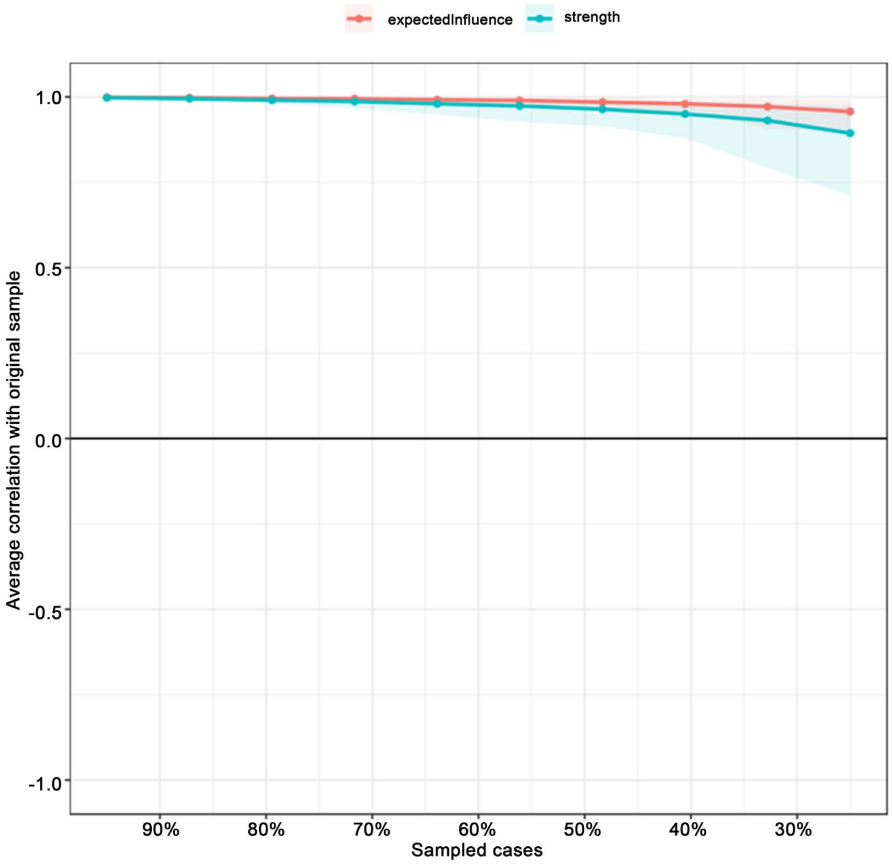

Figure 8. Stability diagram for the centrality indicators of parental control dimensions and anxiety items. Light red and light blue shading denote the range of data fluctuation. The horizontal axis represents the sampling proportion, decreasing from 100% to 0%. The vertical axis denotes the correlation coefficient with the original sample, ranging from −1 to 1.

5. Discussion

Using Psychological Network Analysis (PNA), the present study is the first to systematically elucidate the dynamic interplay between dimensions of parental con-

trol and anxiety symptoms among Chinese adolescents. Drawing on data from 3011 students, we estimated a joint network comprising parental control—indexed by psychological control (PPC) and behavioral control (PBC)—and generalized anxiety symptoms. The analyses confirmed differential effects of specific control dimensions on discrete symptoms and identified core hub nodes within the network. Below, we discuss the findings in terms of network structure, core and bridge mechanisms, implications for intervention, and study limitations.

5.1. Dimension-Specific Associations in the Parental Control-Anxiety Network: Evidence for a Two-Dimensional Model of Control

The network results provide a direct visualization of complex linkages between parental control dimensions and anxiety symptoms. Within-domain analyses showed strong positive connections among the three PPC facets—guilt induction (GI), love withdrawal (LW), and authority/assuredness (AA)—with particularly high edge weight between GI and LW ($\omega = 0.69$). Likewise, in the PBC domain, active solicitation (IS) and behavioral regulation (BR) were tightly linked ($\omega = 0.63$). These findings corroborate Barber's [12] two-dimensional theory: parental control comprises distinct psychological and behavioral dimensions that are not simply opposites but parallel constructs within parenting practices. Most network edges were nonzero (93.33% effective edges within domains) and predominantly positive; however, at the cross-domain level, parental control and anxiety showed an overall negative pattern, partially aligning with H1—namely, positive associations between PPC and anxiety symptoms, but weaker or negative associations for PBC—consistent with a "dosage effect" [47] in which moderate behavioral control may be associated with buffering effects, whereas excessive psychological control is linked to a broader pattern of anxiety cascades.

A notable feature of the topology was "strong within-dimension, weak between-dimension" connectivity: PPC nodes were densely interlinked, while connections between PPC and PBC were relatively sparse. This pattern suggests that different facets of parental control may correlate with adolescent anxiety through distinct psychological correlates, underscoring the theoretical value of disaggregating control into separable dimensions. Bootstrap procedures indicated narrow confidence intervals around edge weights, supporting the accuracy and stability of the estimates.

5.2. Centrality and Bridge Analyses: Targets for Precision Intervention

Centrality metrics identified guilt induction (GI) as the node with the highest strength centrality, positioning it as a core correlate within the parental control-anxiety network and supporting H2. From a developmental perspective, GI is associated with emotion regulation by heightening guilt-related processes, thereby sustaining anxiety over time [48]. On the symptom side, GAD2 (uncontrollable worry) displayed elevated centrality, consistent with cognitive models positing

loss-of-control worry as a hallmark cognitive feature of anxiety [49]. The notably strong GI-GAD2 edge suggests that guilt-inducing control may directly amplify adolescents' uncontrollability concerns, forming a strong reciprocal association.

Bridge analysis further revealed clinically meaningful cross-cluster connections. The link between authority/assuredness (AA) and GAD5 (psychomotor agitation) is particularly salient, implying that authoritarian control may be associated with somatic manifestations of anxiety—consistent with stress theory's psychophysiological pathways [50]. In contrast, active solicitation (IS) showed comparatively weak ties to anxiety items, highlighting the potential buffering role of non-intrusive behavioral control. Stability analyses using case-dropping bootstraps yielded CS coefficients ≥ 0.70—exceeding the 0.50 criterion—indicating robust centrality rankings. Overall, the network approach moves beyond variable-centered models to identify GI and GAD2 as high-priority, mechanism-proximal intervention targets.

5.3. Theoretical Contributions and Practical Implications

This study advances the parental control literature in three ways. First, it provides empirical support for the multidimensional structure of parental control, demonstrating that PPC and PBC engage distinct psychological pathways to anxiety, thereby reinforcing Barber's [12] framework. Second, it reveals symptom-level patterns of co-occurrence that traditional variable-centered methods obscure, aligning closely with network perspectives on psychopathology [28]. Third, it uncovers culturally situated features of the Chinese context, such as the centrality of guilt induction (GI), which may reflect culturally specific emotion–socialization practices (e.g., filial piety), thus offering a vantage point for cross-cultural comparisons.

Practically, the findings provide actionable guidance for precision intervention. Identified hubs—GI and GAD2—constitute primary targets. For GI, we recommend emotion-focused, family-based interventions grounded in Emotion-Focused Therapy (EFT) principles to reduce guilt-inducing practices and to scaffold adaptive emotion socialization. Given the strong association between GI-GAD2, a dual-track "cognitive-emotion regulation" program integrating core components from Cognitive Behavioral Therapy and Acceptance and Commitment Therapy may be particularly effective [51]. Educators and clinicians can translate these insights into tailored protocols: families characterized by elevated GI may benefit from coaching in alternative, autonomy-supportive strategies; adolescents with prominent GAD2 symptoms may profit from group-based or individual cognitive restructuring to weaken catastrophic beliefs about uncontrollability.

6. Limitations and Future Directions

Several limitations warrant consideration. First, the sample was predominantly female (74.16%), which may constrain generalizability. Future studies should recruit more balanced samples and conduct stratified analyses to test whether con-

trol-anxiety mechanisms vary by gender. Notwithstanding this imbalance, the main patterns were theoretically coherent and concordant with prior work [52], suggesting that external validity is limited but internal conclusions remain sound. Second, the cross-sectional design precludes causal inference; longitudinal cross-lagged network models are needed to trace reciprocal influences between control practices and symptoms over time. Third, we did not differentiate paternal and maternal control. Although prior research indicates that PPC elicits anxiety via disrupted emotion regulation and thwarted autonomy needs across both parents [53], future work should parse parent-specific effects. Fourth, all variables were assessed using adolescent self-reports in a single online survey, which may introduce shared-method variance and response-style effects. Although the Harman single-factor test suggested that common method bias was not severe, the absence of parent reports, teacher reports, or other multi-informant data limits our ability to distinguish adolescents' perceptions of parenting from broader family processes. Finally, our sample comprised Chinese high school students from a collectivistic cultural milieu. While we employed localized instruments [31], cultural particularity both narrows generalizability and reduces between-culture noise, thereby sharpening within-culture inference. Cross-cultural replications are needed to evaluate whether the observed features and mechanisms are consistent across sociocultural settings.

7. Conclusion

Adolescent anxiety is tightly linked to academic difficulties, social impairment, and long-term health risks, posing a growing public health concern. Against the backdrop of rising prevalence among Chinese youth [54], this study employed a multi-method framework and PNA on a sample of 3011 students to demonstrate dimension-specific associations within the parental control-anxiety network. The identification of core and bridge nodes—most notably uncontrollable worry (GAD2) and guilt induction (GI)—offers precise leverage points for intervention. By articulating a dynamic, symptom-level interaction framework [28], the findings outline a practical pathway of "identify high-risk families—target core symptoms—disrupt vicious cycles," with meaningful clinical implications for reducing lifetime anxiety risk in adolescence [7].

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Conflicts of Interest

The authors declare no conflicts of interest.

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Supplementary Materials

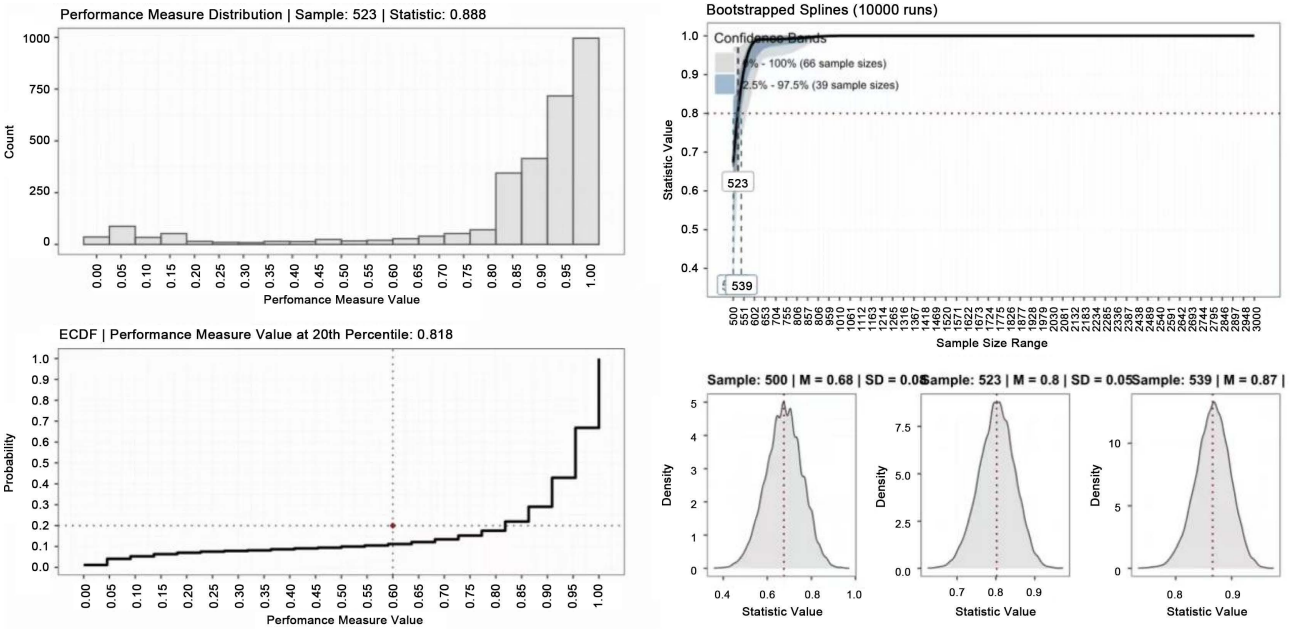
Table S1. The information of the network.

Variables	Dimension	Items/Node	Full List/Definition of Item Texts
Parental psychological control	Guilt Induction	GI	Parents induce guilt in children to manipulate behavior by emphasizing their own sacrifices or disappointments.
	Love Withdrawal	LW	Parents temporarily withdraw emotional care as punishment when children do not meet expectations.
	Authority Assertion	AA	Parents emphasize absolute authority and deny children autonomy.
Parental behavioral control	Inquiry Solicitation	IS	Parents take the initiative to learn about their children's daily activities, social relationships, etc.
	Behavioral Restriction	BR	Parents set clear rules and monitor their enforcement, regulating the boundaries of their child's behavior.
Generalized anxiety	/	GAD1	1) Feeling nervous, anxious or on the verge of a breakdown
		GAD2	2) Inability to stop or control worry
		GAD3	3) Worrying too much about various things
		GAD4	4) Difficulty in relaxing
		GAD5	5) Being so restless that it is difficult to sit still
		GAD6	6) Becoming easily annoyed or irritable
		GAD7	7) Feeling as if something bad is going to happen and being afraid of it

Supplementary Results

Result S1 ***Sample size estimation result.***

The sample size estimation indicated that a minimum total sample of 523 participants was required. The upper-left panel presents the histogram of statistical power values (observed value = 0.888); the upper-right panel shows the confidence intervals obtained from 10,000 bootstrap resamples with spline fitting (sample sizes 523 vs. 539). The lower-left panel displays the empirical cumulative distribution function (ECDF), with the 20th percentile equal to 0.818. The lower-right panel illustrates the density distributions of statistical values under different sample sizes (500/523/539), indicating that the standard deviation was smallest at a sample size of 523 ($SD = 0.038$).



Result S2 ***Common Method Biases***

The critical standard of 40% is a benchmark used to evaluate the severity of common method bias in self-reported data (Tang & Wen, 2020), as suggested by Podsakoff *et al.* (2003). In our exploratory factor analysis with the Harman single-factor test (Zhou & Long, 2004), the first factor accounted for 31.13% of the variance, which is below this threshold, indicating that common method bias was not a substantial issue in our study.

Supplementary Figures

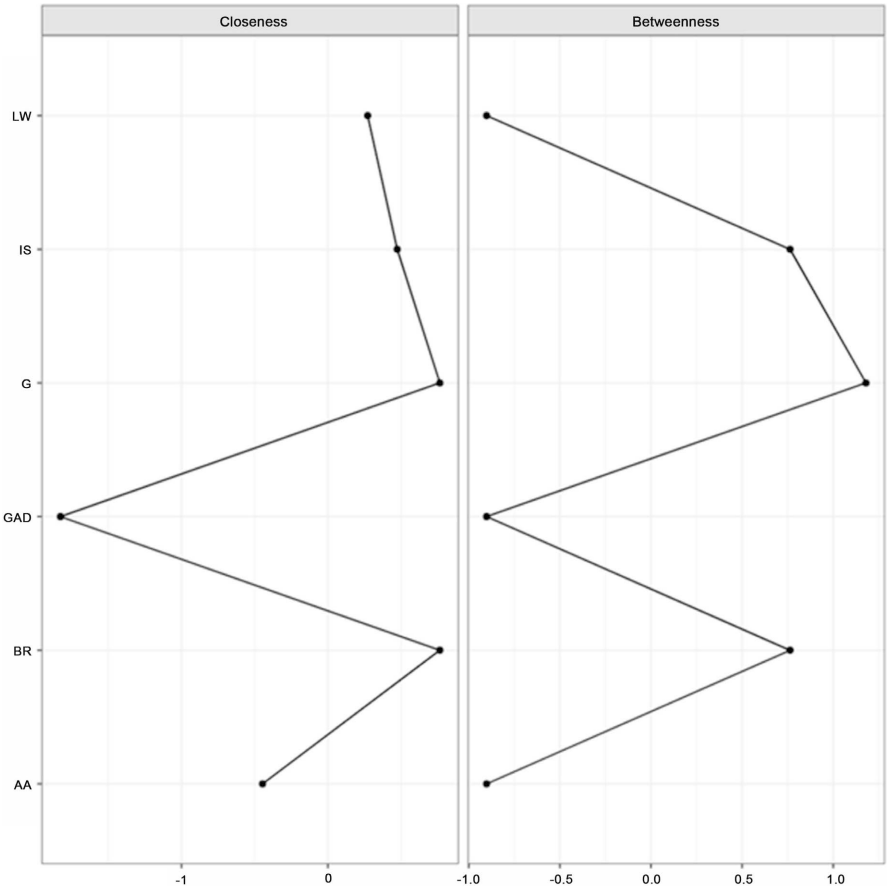


Figure S1. Centrality diagram for the dimensions of parental control and anxiety, illustrating compactness and mediation. Note: GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GAD = Generalized Anxiety Disorder.

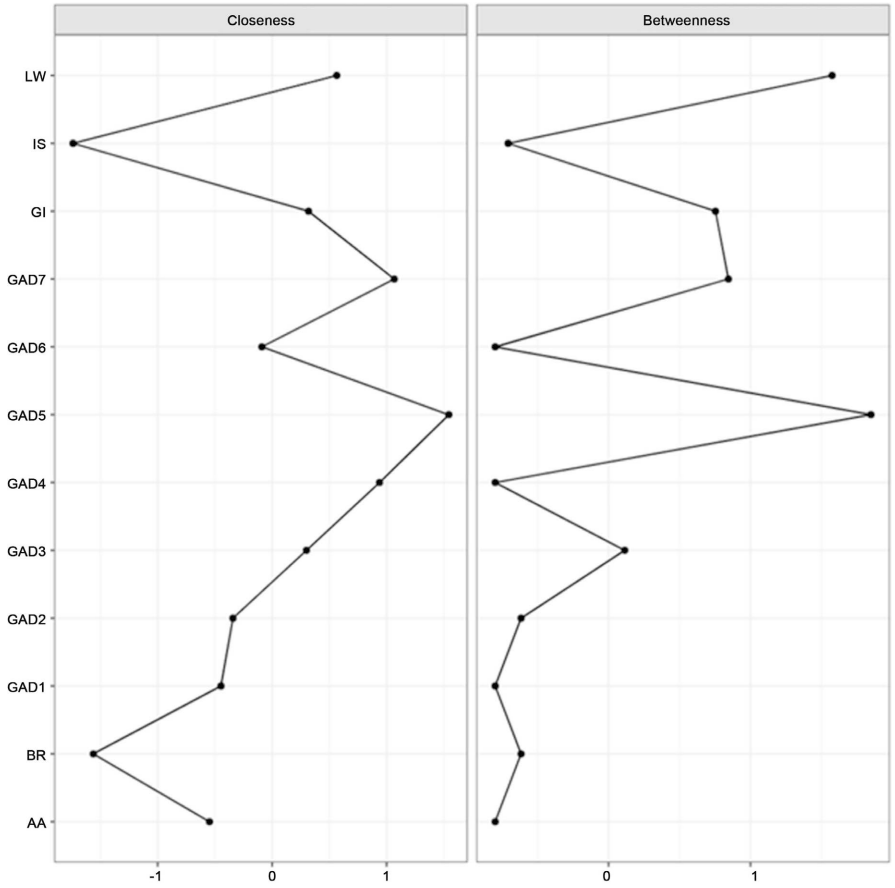


Figure S2. Centrality diagram for the tightness and mediating role of the parental control dimension and anxiety items. Note: GI = Guilt Induction; LW = Love Withdrawal; AA = Authority Assertion; IS = Inquiry Solicitation; BR = Behavioral Restriction; GAD = Generalized Anxiety Disorder.