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Postprint: Strategic Intelligence Analysis of Juvenile Delinquency from the Perspective of Criminal Subject Social Networks

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Abstract

[Purpose/Significance] From a novel perspective focusing on the criminal subject, and taking crimes committed by the same subject type as the research object, this study proposes a research framework for juvenile delinquency phenomena structured as “intelligence source-subject-case-crime problem”. This framework aims to analyze the causes and characteristics of juvenile delinquency, as well as the influencing factors of criminal subjects within juvenile delinquency cases, thereby revealing the underlying patterns of juvenile delinquency and providing enhanced strategic intelligence analysis approaches for the prevention, control, and governance of juvenile delinquency in practice. [Method/Process] Employing text analysis and social network analysis methods, this study establishes crimes of the same subject type—rather than individual cases—as the intelligence research object. By extracting information related to criminal subjects from samples of such cases, it constructs a social network of criminal subjects and conducts corresponding theoretical discussions and empirical research. [Results/Conclusion] The research demonstrates that social network analysis is applicable to the study of juvenile delinquency phenomena within certain scopes. Strategic intelligence analysis of juvenile delinquency based on the social network of criminal subjects facilitates the objective revelation of crime patterns and characteristics inherent to such special subjects, uncovers influencing factors of criminal subjects, and can provide effective assistance and decision-making support for implementing strategic intelligence analysis of juvenile delinquency.

Full Text

Strategic Intelligence Analysis of Juvenile Delinquency from the Perspective of Criminal Subject Social Networks

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Abstract

[Purpose/Significance] This paper adopts the criminal subject as a novel perspective, focusing on crimes committed by the same type of subject as the research object. It proposes a research framework of “intelligence source–subject–case–crime problem” for analyzing juvenile delinquency phenomena, examining the causes and characteristics of juvenile crimes as well as the influencing factors of criminal subjects in juvenile crime cases, thereby revealing the patterns of juvenile delinquency to provide more strategic intelligence analysis insights for the prevention and governance of juvenile crime in practice. **[Method/Process]** Using text analysis and social network analysis methods, the study establishes same-subject-type crime problems rather than individual cases as the intelligence research object. By extracting information associated with criminal subjects from case samples, it constructs a criminal subject social network for theoretical discussion and empirical research. **[Result/Conclusion]** Research demonstrates that social network analysis is applicable to studying juvenile delinquency within a certain scope. Strategic intelligence analysis of juvenile delinquency based on criminal subject social networks helps objectively reveal the patterns and characteristics of such special-subject crimes, identify influencing factors of criminal subjects, and provide effective support and decision-making assistance for implementing juvenile crime strategic intelligence analysis.

Keywords: social network; juvenile delinquency; criminal subject; strategic intelligence

2 Research Background

Existing crime intelligence analysis and assessment methods include qualitative analysis, quantitative analysis, empirical analysis, information analysis, logical thinking, practical operation, and specialized investigative and criminological methods. The advent of the big data era has injected new ideas into juvenile delinquency strategic intelligence analysis, making it feasible to use all-source data as the research object and rely on information technology to mine interrelationships among data and reveal overall crime patterns. Social network analysis is a quantitative method formed by the organic integration of social theory with applied mathematics, statistics, and computational methodology. It provides a set of methods and norms for analyzing social relationship structures and their

attributes, revealing and describing the underlying structures of social relations by studying network patterns hidden beneath complex social system representations.

Current applications of social network analysis in crime research both domestically and internationally have primarily focused on the objective elements of crime, studying organized crime, terrorist acts, drug trafficking, financial crimes, gang fraud, theft, and organized crime through single-case approaches. In organized crime research, scholars have analyzed criminal networks to deconstruct criminal organizational systems, structural characteristics, and operational targets. Studies have examined the network structure and operational patterns of terrorist organizations, with F. Varese using SNA to study the network structure of organized crime using the Russian Mafia in Italy as an example, including analysis of female criminal subject roles. In financial crime research, social network analysis has been used to mathematically model massive financial transaction data through weighted calculations to construct SNA community diagrams for studying illegal transaction gangs, with foreign scholars focusing on potential applications of SNA technology in financial crime fields. In drug trafficking research, SNA and spatial analysis techniques have been applied to cross-border drug crimes and illegal pharmaceutical crimes to analyze organizational structural characteristics. In geographical crime analysis, researchers have established networks using criminals' geographical origins as nodes and gang relationships as connections. S.M. Radil utilized spatialized network data to compare the competitive relationships of violent crime locations between street gangs and groups involved in violent crime on a specific Los Angeles road segment, exploring the application of social network analysis in criminological geography. Other studies have empirically examined criminal network knowledge discovery frameworks, SNA application patterns in public institutional information communication networks, and criminal network resilience based on efficiency and security performance.

However, these existing applications of social network analysis in crime research have mostly analyzed criminal network organizational structures from the perspective of objective crime elements, paying little attention to the special attributes of criminal subjects themselves, such as social network analysis of special-subject crime problems. Moreover, research has typically focused on individual cases rather than crime phenomena and problems of the same subject type as research objects. Since juvenile criminal subjects have distinct special attributes—their mental development is not fully mature and their cognitive abilities regarding objective matters are limited—they are often influenced by various factors during crime commission. Therefore, this paper applies social network analysis methods to juvenile delinquency strategic intelligence analysis, focusing on the inherent attribute relationships of criminal subjects, constructing social networks of criminal subjects involved in juvenile delinquency cases, analyzing intelligence correlation relationships related to criminal actors, discovering crime phenomena of the same subject type, and objectively revealing the characteristics, patterns, changes, causes, and social influencing factors of juve-

nile delinquency. This provides scientific decision-making basis and support for implementing juvenile delinquency strategic intelligence analysis, aligning with the development trend of advanced crime intelligence assessment in the big data era.

3 Data Processing and Research Process

3.1 Data Source and Processing

Given the aforementioned situation of high juvenile crime rates in rural China, to enhance the pertinence, completeness, and feasibility of exploratory research, and drawing on the case analysis method in crime intelligence analysis that takes overall criminal cases in a certain area during a certain period as the research object, this study selected litigation materials from all concluded juvenile delinquency cases in a remote Chinese county from 2014 to 2016 as intelligence source samples. This ensured the completeness and reliability of research samples. Statistical analysis revealed that juvenile delinquency cases in this county during the three-year period involved four categories: robbery, rape, assault, and drug trafficking, with 127 suspects total, including 58 juvenile suspects, most from left-behind or single-parent families. According to China's current criminal law and criminal procedure law provisions, all suspects' real names have been anonymized in the following analysis. To verify whether this research yields conclusions consistent with reality, the criminal prosecution opinions from the aforementioned concluded juvenile delinquency cases were used as comparative data. Comparison revealed that results obtained through this research method regarding juvenile delinquency in this county were consistent with the sentencing determinations for juveniles in the prosecution opinions. According to relevant legal provisions, specific names of the prosecution opinions have also been anonymized in the following discussion.

3.2 Construction of Criminal Subject Social Network

The construction of the criminal subject social network 主要包括 three steps:

3.2.1 Identification and Extraction of Criminal Subjects

Since litigation material data texts for juvenile delinquency cases have standardized and uniform formats, subject identification and extraction are objective and unique. Names of individuals in the suspect field (with consistent name and ID number) were extracted as nodes in the criminal subject social network.

3.2.2 Definition of Criminal Subject Relationships

Using text analysis methods, verbs describing criminal actions committed by subjects during criminal activities were extracted from sample data texts. The mutual contact relationships between criminal subjects' actions served as edges between nodes in the criminal subject social network, forming subject relationships and constructing an undirected one-mode network.

3.2.3 Assignment and Weighting of Criminal Subject Relationships

Based on extracted verbs describing criminal actions between subjects during criminal activities, guided by China's criminal law theories on joint crime and joint crime sentencing, and considering the constitutive elements of specific crimes (primarily objective and subjective behavioral elements), the semantic meanings of these verbs were categorized according to their actual contribution to the criminal process. Drawing on China's sentencing theory that assigns different weights to different behaviors by criminal subjects, the extracted verbs representing contact relationships between criminal subjects were divided into five levels with assigned weights: indispensable relationship = 1; joint implementation relationship = 0.75; auxiliary relationship = 0.5; participation relationship = 0.25; no relationship = 0. For example, principal offenders, accomplices, coerced participants, instigators, and accessory offenders receive different punishments based on their different roles in the crime, with principal offenders having greater influence than accomplices, followed by accessory offenders and coerced participants. These weight assignments are based on China's criminal law theory that evaluates different contributions to criminal activities during conviction and sentencing, making them objective, scientific, and reasonable.

3.3 Analysis and Results of Juvenile Delinquency Subject Social Network

Based on the constructed juvenile delinquency subject social network, UCINET analysis software was used to conduct comprehensive correlation analysis from three dimensions: network structure, network centrality, and cohesive subgroups, with NETDRAW software employed for visual analysis and presentation of juvenile delinquency status, patterns, and characteristics.

3.3.1 Analysis of Juvenile Delinquency Network Structure Morphology Network density and standard deviation were used to measure the cohesion degree of juvenile delinquency networks. Density is the ratio of actual connections to all possible connections in a network, representing the proportion of existing edges to maximum possible edges. Values closer to 1 indicate tighter connections among network members. The calculation formula is:

$$N(N - 1)$$

(Formula 1)

where N is the number of criminal subjects in the network and L is the actual number of connections among N criminal subjects.

Standard deviation is the square root of the arithmetic mean of squared deviations of individual values from their mean, reflecting dispersion among group members. The calculation formula is:

$$(x_i - \mu)$$

(Formula 2)

where N is the number of criminal subjects, x_i is the value assigned to the i -th criminal subject, and μ is the mean value of all criminal subjects.

The juvenile delinquency network structure morphology in this county is shown in Figure 1 [Figure 1: see original paper]. The visualization uses different colors for different crime types, circular nodes for juveniles, and line thickness to represent relationship closeness. The analysis reveals that juvenile delinquency in this county during the specified period mainly involved four crime types: drug trafficking, robbery, intentional assault, and rape. Robbery accounted for 47.37%, drug trafficking and intentional assault each accounted for 21.05%, and rape accounted for 10.53%, indicating robbery as the primary crime type. Juvenile suspects comprised 66.67% of robbery subjects, 42.86% of rape subjects, 32.35% of assault subjects, and 25.64% of drug trafficking subjects, representing 45.67% of all suspects. Juvenile involvement was highest in robbery crimes, while rape cases involved the fewest juveniles but had relatively high juvenile participation rates. Juvenile participation was lower in assault and drug trafficking cases.

The network exhibited chain-like or mesh-like structures with a density of 0.0349 and standard deviation of 0.1658—significantly higher than the density value—indicating loose relationships among criminal subjects, low speed and efficiency of information flow, dispersed network structure, and poor network cohesion. Juvenile nodes were mostly connected to adult nodes, distributed across different relationships according to various attributes, with interconnections among robbery, assault, and drug trafficking cases. This suggests that juvenile delinquency activities in this county lacked organization, with few juveniles committing crimes alone and frequent adult involvement in joint crimes, likely representing mostly spontaneous offenses. In practice, prosecution opinions identified multi-participant cases as joint crimes, with criminal intent in multiple robbery and assault cases involving drug-related crimes.

3.3.2 Analysis of Juveniles' Force and Influence in Criminal Activities

Network centrality was analyzed using three indices: degree centrality, closeness centrality, and betweenness centrality to measure juvenile criminal subjects' positions.

Degree centrality measures a specific node's activity, calculated by the number of points connected to it:

$$CD(k) = \sum a(i, k)$$

(Formula 3)

where n is the total number of criminal subject nodes and $a(i, k)$ is a binary variable indicating whether a link exists between subjects i and k . Higher degree centrality indicates greater influence.

Betweenness centrality measures a node's intermediary influence on shortest paths between any two nodes:

$$CB(n_i) = \sum g_{jk}(n_i)/g_{jk}$$

(Formula 4)

where g_{jk} is the number of shortest paths between subjects j and k, and $g_{jk}(n_i)$ is the number of those paths passing through subject i. Higher betweenness centrality indicates important communication roles.

Closeness centrality measures the sum of geodesic distances between a specific node and all other nodes:

$$CC(n_i) = \frac{1}{\sum d(n_i, n_j)}$$

(Formula 5)

where $d(n_i, n_j)$ represents the number of shortest paths connecting subjects i and j. Lower closeness centrality indicates greater direct influence and propagation impact.

The centrality analysis of this county's juvenile delinquency network structure is shown in Figure 2 [Figure 2: see original paper], with top 10 rankings for each centrality measure presented in Table 1 .

Analysis reveals that drug trafficking and robbery networks showed clearer centrality. One juvenile node ("Fatty") had the highest degree centrality in the drug trafficking network, while another juvenile ("Lü Chang-x") had the highest degree centrality in the robbery network, indicating these juveniles occupied high-resource positions and could effectively control and influence other actors. Assault and rape networks showed less pronounced centrality with multiple high-degree nodes, including two juveniles (Wang Bin and Peng Yuan-x), suggesting tight yet independent relationships among subjects.

Robbery and assault networks contained many independent nodes not controlled by others, including six juvenile nodes (Yan Fu-x, Yan-x, Chen Yue-x, Zeng-x, Wang X-guo, and Du X-lian) with low closeness centrality, indicating strong autonomy. Drug trafficking and rape networks showed higher closeness centrality, suggesting stronger interdependence. Four juvenile nodes (Fatty, Peng-b, Song XX, and Lü Chang-x) had high betweenness centrality in drug trafficking and robbery networks, occupying key information flow positions with high activity and bridging roles. Juvenile nodes in assault networks had low betweenness centrality, indicating limited roles, while rape networks showed uniformly low betweenness centrality with smooth information flow and high activity consistency.

These findings align with prosecution opinions regarding juveniles' behavioral nature and roles. Few juveniles held core leadership positions, mostly playing

auxiliary roles. Most juvenile nodes had high closeness centrality, indicating low propagation influence and high adult control. Only 27.78% of juveniles had high betweenness centrality, showing limited communication roles and low activity.

3.3.3 Analysis of Juvenile Delinquency Organization, Gang Characteristics, and Scale This was primarily achieved through cohesive subgroup analysis. Cohesive subgroups are subsets of actors with stable, direct, strong, frequent, or positive connections. The closer actors are connected, the more susceptible they are to group norms. Main types include “factions” and “components.” Cohesive subgroup analysis can reveal gang characteristics, organizational structures, and behavioral features, exposing the gang nature, organization, and patterns of juvenile delinquency.

Faction Analysis

Table 2 shows all factions in this county’s juvenile delinquency network. The network comprised 36 factions with 3-11 members each; factions with 3-4 members were most common. Juvenile and adult criminal subjects integrated into multiple factions, with only three factions (14, 32, and 34) containing no juveniles. Several juveniles belonged to multiple factions (e.g., Fatty, Lü Chang-x, Peng-yang), indicating high mobility across different criminal activities and creating interconnections among robbery, assault, and drug trafficking cases. Faction analysis provides investigation leads and prevention bases.

Hierarchical clustering analysis of these factions (Figure 3 [Figure 3: see original paper]) revealed that at similarity level 1.0, the 36 factions clustered into seven categories. The member-sharing model showed that factions 1-10 shared two members (“Erlangshen” and “Fatty”), clustering them into one category. This analysis further revealed organizational characteristics, showing cross-cutting among drug trafficking, assault, and robbery crime factions.

Component Analysis

Component analysis results are shown in Figure 4 [Figure 4: see original paper]. The network had a component distance of 0.893 and contained 16 components, with 13 comprising three or more nodes: drug trafficking (2 components), robbery (7 components), assault (3 components), and rape (1 component). The cohesive subgroup density was 0.230, indicating random distribution of node relationships and infrequent communication among factions/components.

Faction analysis shows numerous factions with cross-cutting crime types. Component analysis reveals weak unity and organization, with relatively more participants in drug trafficking, robbery, and assault cases, low rape incidence, and juvenile delinquency concentrated in assault, robbery, and drug trafficking. The region’s juvenile delinquency shows weak organization, strong gang characteristics, and small scale.

4 Conclusion and Discussion

The analysis shows that juvenile delinquency in this county is mostly spontaneous and episodic, concentrated in assault, robbery, and drug trafficking. Criminal activities lack organization and effective unified planning. Juveniles rarely occupy core leadership positions, mostly playing auxiliary roles. Individual juvenile crimes are rare, typically involving adult co-participation. Drug trafficking, robbery, and assault crimes are interrelated, with one crime motivating another (e.g., drug-related robbery leading to assault). Analysis of case data revealed that 90% of juvenile suspects came from left-behind or single-parent families with severely deficient rational family education, preventing them from developing correct values to resist social temptations.

Drawing on the “fishing net model” from information analysis theory, the criminal subject-based social network includes both crime relationship networks generated by criminal activities and social relationship networks generated by social life. The overlapping network (shaded area in Figure 5 [Figure 5: see original paper]) represents other social relationship information related to the subject, expanding the breadth and depth of crime intelligence collection and analysis, often providing breakthrough points for strategic intelligence analysis and rich sociological backgrounds for studying similar crime types.

The proposed strategic intelligence analysis based on criminal subject social networks examines crime intelligence from the subject perspective. Connections in crime relationship networks primarily involve information related to objective and subjective crime elements, including people, events, objects (tools, traces), time, space, and behaviors. Social relationship network connections involve personal identification information (blood relations, marital relations, personal identity), social experience information (education, work), legally collected information (DNA, fingerprints, criminal records, credit), and other life information. Through these connection points, subjects continuously generate associations, forming specific social network structures through which crime intelligence flows.

This approach visualizes case logic and relationship networks following the “intelligence source–subject–case–crime problem” chain, enabling advanced assessment of same-type crime strategic intelligence and providing strategic decision-making support for crime control. It achieves a big data-era circular utilization process from “intelligence to intelligence product to intelligence” (Figure 6 [Figure 6: see original paper]). For juvenile delinquency, this model helps objectively display criminal network organizational structures, identify crime patterns, and enhance crime pattern recognition. It reveals crime hotspots and patterns, analyzes group characteristics of juvenile criminal subjects, explores related influencing factors, enhances crime intelligence early warning capabilities, and extracts typical occurrence elements of specific crime types to support crime reasoning. This positions intelligence analysis before police decision-making, providing scientific support for implementing juvenile delinquency strategic intelligence analysis with practical feasibility and significance for preventing and

controlling juvenile crime.

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Author Contributions:

Huang Qian: Designed research topic, framework, and structure; wrote and revised the paper.

Hei Jingjie: Revised paper; constructed theoretical frameworks for jurisprudence and criminology content.

Cao Fenfang: Collected and organized materials.

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Abstract: [Purpose/Significance] This paper takes the criminal subject as a new perspective, focusing on crimes of the same subject type as the research object, and proposes a research framework of “intelligence source–subject–case–crime problem” for analyzing juvenile delinquency phenomena. It analyzes the causes and characteristics of juvenile delinquency and influencing factors of criminal subjects in juvenile crime cases, revealing patterns of juvenile crime to provide more strategic intelligence analysis for preventing and governing juvenile delinquency in practice. [Method/Process] Using text analysis and social network analysis methods, the study establishes same-subject-type crime problems rather than individual cases as the intelligence research object. By extracting information associated with criminal subjects from case samples, it constructs a criminal subject social network for theoretical discussion and empirical research. [Result/Conclusion] Studies demonstrate that social network analysis is applicable to juvenile delinquency research within a certain scope. Strategic intelligence analysis of juvenile delinquency based on criminal subject social networks helps objectively reveal crime patterns and characteristics of such special subjects, explore influencing factors of criminal subjects, and provide effective support for implementing juvenile delinquency strategic intelligence analysis.

Keywords: social network; juvenile delinquency; criminal subject; strategic intelligence

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