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Spatial Construction and Grassroots Willingness to Participate in Democracy: Analytical Framework and Empirical Tests

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KEYWORDS

Spatial Construction, Democratic Participation, Grassroots Democracy, NPC deputies' contact stations

ABSTRACT

In China, political participation exists as a mainstream understanding of democratic politics. There are many factors that influence citizens' willingness to participate, often pointing to some form of "space", but few studies have explored the relevance of different forms of space to the willingness to participate in democracy. This study focuses on the grassroots space of NPC deputies' contact stations in China and utilizes data collected from 185 contact stations for empirical analysis. The study adopts the physical, interactional and digital spaces identified in established research and operationalizes their variable indicators, on the basis of which an analytical framework is constructed and hypotheses are formulated. The empirical results show that there is a significant positive correlation between the improvement of the three types of spatial conditions and the willingness to participate in grassroots democracy. It has been proved that promoting grassroots democratic participation willingness through spatial constructs has a positive performance. This study aims to make an empirical test to support the spatial examination of democratic participation and provide an understanding of the spatial construction of grassroots democracy in China.

1. Introduction

Political participation is a necessary part of institutional practice in modern democracies. It is undeniable that some excessive or low-quality participation behaviors have brought bad populist consequences [1]. However, the facilitating role of political participation in democratic innovation is still being heavily explored [2]. Theories of participatory democracy, consultative democracy, and social capital all declare the positive impact of civic engagement in democratic politics [3]. Of course, one thing to be pointed out is that modern political societies have different degrees of democratic development and democratic system pursuits, which brings about different characteristics and forms of democratic participation behaviors.

This study of China's democratic political development is brought into focus. China is an influential world power and the largest developing country. Political participation has become the most popular concept of democracy in China [4], and the majority of the Chinese population views democracy as political participation [5]. Under these circumstances, how can the CPC and the Chinese government promote the orderly political participation of the people in a grassroots society with a huge population size? The Chinese Government has proposed "people's democracy in the whole process" as a discursive expression of Chinese-style democracy, and the expansion of people's orderly po-

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litical participation has been identified by the Chinese Government as an important element in the development of people's democracy in the whole process. Chinese President Xi Jinping emphasized that this form of democracy has not only complete institutional procedures, but also complete participatory practices.1 Against this background, China has implemented a larger-scale construction program for grass-roots democracy units, with NPC deputies' contact stations, grass-roots legislative contact points, and other major components, on the basis of earlier explorations, and has become an important platform and spatial carrier for enriching direct democratic participation at the grass-roots level.

In China's officially promoted system of grassroots democratic spaces, the functional positioning of NPC deputies' contact stations is closest to the research question of democratic participation 2. As a practical product of the system of people's congresses, the NPC deputies' contact stations are positioned as a platform for the expression of democratic public opinion by the Chinese people's congresses at all levels, and as a legal position for NPC deputies to communicate with the people. The Chinese Government attaches great importance to the construction and functioning of NPC deputies' contact stations. At present, most towns and streets in China have set up at least one NPC deputies' contact station 3, where NPC deputies are responsible for receiving people who come to give feedback on their problems and put forward suggestions. Against this background, the contact station of the National People's Congress (NPC) deputies was selected for this study as an investigative object to examine democratic participation at the grassroots level, focus on how the construction of this site affects the willingness of people to participate at the grass-roots level.

The literature closely related to this study focuses on the various influences on democratic participation. First, the subjective dynamics of democratic participation behavior were identified as including factors such as political trust and sense of efficacy [6-8], distribution of benefits in the political economy [9,10], and psychological characteristics of actors [11,12]. Second, some recent studies have increasingly emphasized the role of gender in influencing democratic participation [13-15]. Finally, and in the branch to which this study belongs, the researchers examined the external influences on various democratic participation behaviors. The quality of civic education is crucial [16], smaller city sizes act as mediators linking a sense of political efficacy and political participation [17], the Internet and media platforms expand opportunities for political participation [18], and the range of social interactions and activities mobilizes certain acts of political participation [19]. Most of these externalities can be included in some sense of "space", although they may take different forms. For example, an examination of urban scale points to the physical attributes of space, a study of the range of social interactions can be understood as a space of subjective interactions, and a focus on the Internet and media points to a new type of space spawned by digital technology. This study of spatial influences on democratic participation activities still has room for expansion. On the one hand, the existing literature has considered different forms of spatial factors, but their combined effects are not yet clear. On the other hand, how the physical, social, and digital attributes of space are presented on the same object has also not yet received attention. In this sense, the following research questions are posed in relation to the object selected for this paper.

RQ. Does the degree of refinement of spatial constructs on different attributes and indicator performance promote or inhibit willingness to participate in grassroots democracy?

The paper is structured as follows. Section 2 provides a theoretical analysis and formulates the research hypotheses. Section 3 describes the variables, data and models of the study. Section 4 presents the components and results of the empirical analysis. Section 5 provides conclusions and related discussions.

2. Theoretical Analysis and Hypothesis Development

2.1. Physical Space and the Willingness to Participate in Grassroots Democracy

The spatial dimension of democracy has received a great deal of attention and research in theory and practice. These studies begin with the physical properties of space. The first and foremost property of any space is physicality. In the realm of democratic politics, the public squares of ancient Athens provided a plain experience of physical spatial conditions. The development of modern democracies has increased the demand for public space brought about by various kinds of democratic participation [20]. Research in democratic geography argues that democracies must design public spaces that can accommodate democratic participation in the process of governance [21]. Such spaces include both high-level venues for representative democracy such as the U.S. Capitol and the Great Hall of the People in China, but also point to informal urban street design [22]and specialized spaces for political activity such as community councils [23]. In short, the physical space of democratic participation points to a precise physical place.

In conjunction with the object of our investigation, the grassroots democratic space of the NPC deputies' contact station exists first and foremost as a field with physical attributes. In terms of physical spatial conditions, this includes two main conditions: space siting and functional comprehensiveness. The location of NPC deputies' contact stations should be planned to facilitate the political participation of grass-roots people, and should not be too far away from the communities or villages under their juris-

diction. Functionally, it can explore the integration and co-construction of such venues as party service centers, linking up the democratic links of Leadership of the Communist Party of China, government governance and villager self-governance. Through the structural reorganization and functional integration of the old space, a comprehensive space for democratic participation can be created, so that it can better meet the practical requirements of democratic participation. Based on the above analysis, the following research hypotheses are proposed.

H1. There is a positive correlation between the degree of perfection of physical space conditions and the willingness of grassroots democratic participation.

*H1a.*The closer the location of the space is to residential areas, the better the performance of grassroots democratic participation willingness.

H1b. The more comprehensive the spatial functions are, the better the performance of grassroots democratic participation willingness.

2.2. Interaction Space and the Willingness to Participate in Grassroots Democracy

Part of the spatial research on democratic participation has implications for the space of democratic interaction identified by Habermas. Democratic political practice is essentially an activity of human interaction, and the electoral, debating, and deliberative activities of people from different levels of democracy constitute this space. Unlike the physical level of space, the everyday activities of communicating, sharing, and negotiating constitute this space of engagement [24]. Indeed, the social interactions that come with managing the physical space constitute another space, and it is this that produces and reproduces people's democratic participation. The geographies shaped by this participatory space think about and practice interactions that drive different expressions of democratic politics [25].

Taking into account the functional positioning of NPC deputies' contact stations in the structure of the democratic system and grass-roots practice, the construction of the interaction space of NPC deputies' contact stations mainly includes three conditions: the representative level, the actor synergies and the feedback of public opinion. First, under the framework of the people's congress system, China has five levels of people's congresses: national, provincial, municipal, county, and township, and the differences in the hierarchical structure represent, to some extent, differences in the level of political resources and feedback of public opinion. Second, social problems at the grassroots level often involve multiple political subjects, and since grassroots NPCs often need to refer specific problems of their constituents to the relevant government departments for resolution, the ability of subject synergy has become an important indicator of the construction of the interaction space. Finally, the extent to which the NPC deputies' contact stations are able to absorb public opinion and wisdom and form proposals for feedback to higher-level NPCs or relevant government departments is also an important factor influencing the political participation of grass-roots people who enter the stations to implement their political participation. Based on the above analysis, the following research hypotheses are proposed.

H2. There is a positive correlation between the degree of richness of interaction space conditions of and the willingness of grassroots democratic participation.

H2a.The richer the representative hierarchical structure of the space, the better the performance of grassroots democratic participation willingness.

*H2b.*The stronger the synergy of spatial actors, the better the performance of grassroots democratic participation willingness.

*H2c.*The stronger the spatial feedback capacity of public opinion, the better the performance of grassroots democratic participation willingness.

2.3. Digital Space and the Willingness to Participate in Grassroots Democracy

Time and space constraints are a problem that modern countries inevitably face in promoting democratic politics. For grass-roots societies with complex social structures, highly mobile populations and pluralistic interests, such time and space constraints inevitably impose constraints on large-scale democratic participation and the integration of wills. The advent of the digital age has given rise to various forms of technological space. The digital space of democratic participation must be given sufficient attention. There have been studies analyzing the public space issue of democratic participation in the digital realm [26], and the social and private spaces defined by digital technologies are reconfiguring the inclusive space of democratic politics [27]. In order to adapt to this change, state and government departments have continued to open online channels for political participation, and various informal media platforms have further expanded opportunities for democratic participation. The creation of a digital platform for NPC deputies' contact stations will enable grass-roots democratic participation to break through time and space constraints, upgrading from inbound participation on voter reception days to all-weather online participation. However, as timely information dissemination and response to voters are important conditions for effectively improving the quality of democratic participation, realizing the interoperability and integration of digital space platforms and offline information is an indispensable link. Based on the above analysis, the following research hypotheses are proposed.

H3. There is a positive correlation between the degree of improvement of digital space condition and the willingness of grassroots democratic participation.

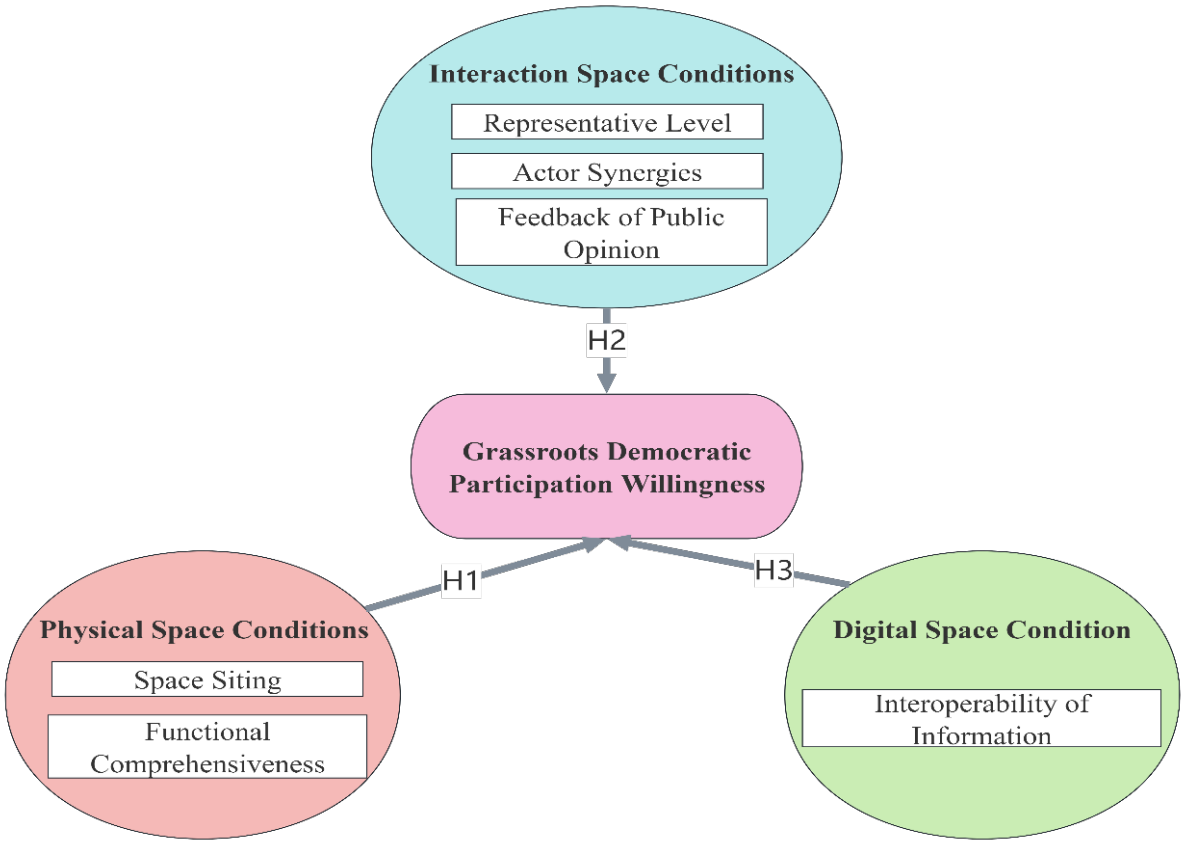

Figure 1 | An analytical framework for spatial constructs and willingness to participate in grassroots democracy

*H3a.*The higher the degree of information interoperability in digital space, the better the performance of grassroots democratic participation willingness.

Figure 1 illustrates an analytical framework that combines specific indicators of physical, interactional, and digital spatial conditions to understand the relationship between spatial constructs and the willingness to engage in grassroots democracy.

3. Data, Variables and Model

3.1. Data Sources

This study conducted a questionnaire survey and data collection in Xinxiang City, Henan Province. Xinxiang City is located in the northern part of Henan Province, and since the opening of the construction of NPC deputies' contact stations in 2019, it has achieved remarkable results in the creation of grass-roots demonstration points for NPC deputies' contact with the masses and whole-process people's democracy, and NPC deputies' contact stations represented by X Street in H District have been highly recognized by the Standing Committees of the People's Congresses of the municipal and provincial levels, and has been listed as the "Star-level Contact Station of the National People's Congress in Henan Province" and "Grassroots Demonstration Point of People's Democracy in the Whole Process in Henan Province", and attracted visits and exchanges of the National People's Congresses of all levels in and out of the province such as Yueyang City of Hunan. From May to August 2024, the research group collected valid data through questionnaires from 185 NPC deputies' contact stations in Xinxiang City, covering Xinxiang City and its counties and cities 4.

3.2. Variable Selection

3.2.1. Explained Variable

The explanatory variable of interest to this study is the grassroots democratic participation willingness. However, there does not exist a universal method for measuring or assigning values to the willingness to participate in grassroots democracy, while there is a lack of statistical analyses of NPC deputies' contact stations in various social survey and assessment databases. Taking into account the research objectives and the actual situation, we exclude the possible influence of other factors on the willingness to participate in grass-roots democracy, and take "residents' willingness to enter the NPC Deputies' contact stations to participate in related activities" as the criterion for measurement, and take the average annual number of times that the NPC

Deputies' contact stations receive voters (online and offline) as a sample of the data for the explanatory variable.

3.2.2. Explanatory Variables

The core explanatory variable of this study is the spatial construction conditions of NPC contact stations, and physical space conditions, interaction space conditions and digital space conditions are taken as the three sub-dimensions of the explanatory variable, and the questionnaire survey is used to measure the performance of the sample contact stations in different dimensions.

In terms of questionnaire design, the physical space dimension includes two sub variables of space siting and functional comprehensiveness. With the distance of the NPC deputies' contact station from the furthest community or village in the jurisdiction (km) as the space siting item, coded as 1-5. The integration and co-construction of NPC deputies' contact stations with community (or village) comprehensive governance centers, grass-roots legislative contact points, CPPCC members' homes, party service centers, conflict mediation centers, and other institutions is used as functional comprehensiveness question item, coded as 1-5.

The spatial dimension of interaction includes three subdimensions, namely, representative level, actor synergies, and feedback of public opinion. With the structure of NPC deputies at the national, provincial, municipal, county (district) and township levels integrated into the contact station as the question item of representative level, coded as 1-5. Take the structure of grassroots party committees, governments, political consultative conferences, social organizations, and enterprise-related personnel participating in the activities of the NPC deputies' contact stations as the actor synergies question item, coded as 1-5.The number of proposals on practical matters concerning people's livelihoods submitted by NPC deputies' contact stations to higher-level NPCs and the number of pieces of feedback on social and public opinions to relevant government departments are taken as the question items of feedback of public opinion, and the value is taken according to the actual number.

The digital space dimension of interoperability of information takes the frequency of information release from online deputy contact stations as the question item of information exchange, coded as 1-5.

3.2.3. Control Variables

Considering the degree of operational perfection of the contact stations of NPC deputies, the population size of different regions and other characteristics, this study includes the establishment time and distribution area of the contact stations of NPC deputies into the control variables. Among them, the establishment time is calculated according to the length of the year (up to 2024) in which the NPC deputies' contact station was established, and the distribution area is assigned a value of 1 or 0 according to whether the NPC deputies' contact station is located in the city or in the countryside (Table 1 for the description of each variable).

3.3. Model setup

Under the influence of spatial factors, the relationship between physical spatial conditions, interaction spatial conditions, digital spatial conditions and the willingness to participate in grassroots democracy is modeled as follows based on the previous assumptions, where α denotes a constant and β denotes a standardized coefficient.

$$\begin{aligned} Gdpw= & \alpha+\beta_1 St+\beta_2 Fc+\beta_3 Rl+\beta_4 As \\ & +\beta_5 Fpo+\beta_6 Ii+\beta_7 Et+\beta_8 Da \end{aligned}$$

Table 1 | Description of variables

Classification		Variable Name	Connotation
Explained Variable		Gdpw	grassroots democratic participation willingness
Explanatory Variables	Physical space conditions	St	space siting
		Fc	functional comprehensiveness
	Interaction space conditions	Rl	representative level
		As	actor synergies
		Fpo	feedback of public opinion
	Digital space condition	Ii	interoperability of information
Control Variables		Et	establishment time
		Da	distribution area

4. Empirical Analysis and Results

4.1. Reliability and Validity Testing

First, the reliability of the collected questionnaires was analyzed by using SPSS (Table 2).Cronbach's α coefficient is an important indicator for measuring the internal consistency reliability of a scale, and its value ranges usually from 0 to 1. Higher values indicate better consistency among question items, i.e., higher reliability. Generally speaking, if the Cronb α coefficient (or folding coefficient) is above 0.9, the reliability of the questionnaire is very good, and between 0.8 and 0.9 indicates good reliability. The standardized Cronbach's alpha coefficient of the questionnaire in this study reached 0.858, indicating that the consistency after eliminating the effect of measurement error in each question item was significantly improved and the internal reliability was good.

After passing the reliability test, the validity of the questionnaire was verified (Table 3). Generally, when the KMO value of the questionnaire is between 0.8 and 0.9, it indicates that it is suitable for factor analysis. In this study, the KMO value is 0.839, which is located in the interval of 0.8 to 0.9, indicating that the correlation between the items is strong and the data is suitable for factor analysis.

Meanwhile, the statistical value of Bartlett's spherical test is usually an approximate chi-square distribution value with degrees of freedom (df) and p-value used to determine the test results. In this study, the approximate chi-square value is 1234.015, the degree of freedom is 15, and the p-value is at the 0.0001% level of significance (marked with ***). The spherical hypothesis was rejected as p was less than the level of significance usually set (e.g. 0.05) and p determined that there was a correlation between the variables, which indicated that the data was suitable for factor analysis.

4.2. Multifactor Analysis of Variance (ANOVA)

Multifactor ANOVA was used to analyze whether different levels of multiple categorical variables had a significant effect on the results. In Table 4, the p-value of each factor is less than the general level of significance (0.05), so the model can be considered to have a good explanatory strength in the whole; the adjusted R^2 value is 0.778, which indicates that it explains 77.8% of the variability of the

Table 2 | Reliability test results

Standardized Cronbach's α coefficient	Item Count
0.858	8

Table 3 | Validity test results

KMO Test and Bartlett's Test		
KMO value		0.839
Bartlett Sphericity Test	Approximate Chi-square	1234.015
	df	15
	P	0.000***

Note: ***, **, * represent 1%, 5%, and 10% significance levels, respectively.

Table 4. Results of multifactor ANOVA

Term	Square Sum	Degrees of Freedom	Equal Square	F	P	R^2	Adjust R^2
Intercept	235903.755	1	235903.755	306.54	0.000***	0.813	0.778
St	45328.804	4	11332.201	14.725	0.000***		
Fc	33773.657	4	8443.414	10.972	0.000***		
Rl	6822.066	4	1705.516	2.216	0.067*		
As	23501.912	4	5875.478	7.635	0.000***		
Fpo	265769.303	53	5014.515	6.516	0.000***		
Ii	49324.922	4	12331.231	16.024	0.000***		
Inaccuracy	299362.691	389	769.57		NaN		

research variables, and has a high explanatory strength. Except for the variable representative level, all the variables show significance at the level, indicating the existence of main effect on the willingness of democratic participation at the grassroots level. The variable representative level, on the other hand, has a borderline significant effect on the willingness to participate in grassroots democracy and may still have a significant effect on the study variables under certain conditions.

4.3. Correlation Analysis

SPSS was used to conduct a PERSON correlation analysis between physical space, interaction space, and digital space conditions and grassroots democratic participation willingness, and the results are shown in Table 5.The results of the Pearson correlation analysis show that there is a significant and positive correlation between the variables and grassroots people's willingness to participate, and the correlation coefficients are all highly statistically significant ($p<0.001$, marked ***), indicating that these relationships are highly statistically reliable.

In order to further demonstrate the correlations between the independent variables and the dependent variable, and between the independent variables, a heat map of the correlation coefficients is plotted (Figure 2). The darker the color in the graph, the stronger the correlation between the variables.

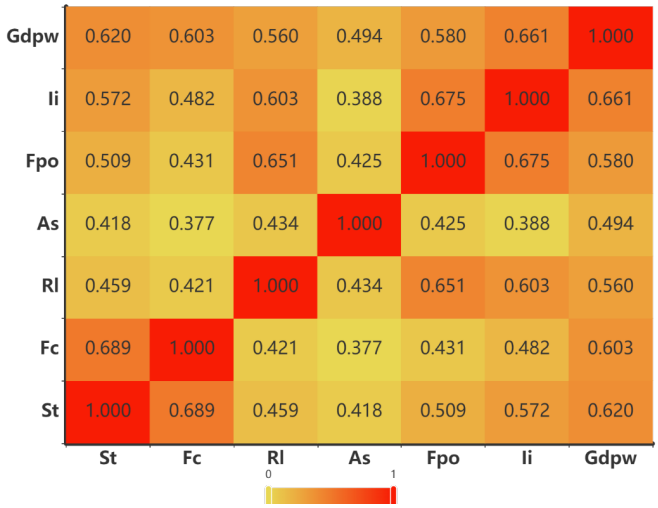

Fig. 2 | The heat map of correlation

4.4. Regression Analysis

With the help of SPSS software, the multiple regression analysis of physical space, interaction space, digital space conditions and grassroots democratic participation willingness was conducted, and the results are shown in Table 6.

In the table, the significance P-value of F-test is 0.000***, which presents significance at the level and rejects the original hypothesis that the regression coefficient is 0, indicating that the model basically meets the requirements; for the covariate manifestation, the VIFs are all less than 10, indicating that the model has no multiple covariate problem, and the model is well constructed.

Table 5 | Results of correlation analysis

	St	Fc	Rl	As	Fpo	Ii	Gdpw
St	1 (0.000***)	0.689 (0.000***)	0.459 (0.000***)	0.418 (0.000***)	0.509 (0.000***)	0.572 (0.000***)	0.62 (0.000***)
Fc	0.689 (0.000***)	1 (0.000***)	0.421 (0.000***)	0.377 (0.000***)	0.431 (0.000***)	0.482 (0.000***)	0.603 (0.000***)
Rl	0.459 (0.000***)	0.421 (0.000***)	1 (0.000***)	0.434 (0.000***)	0.651 (0.000***)	0.603 (0.000***)	0.56 (0.000***)
As	0.418 (0.000***)	0.377 (0.000***)	0.434 (0.000***)	1 (0.000***)	0.425 (0.000***)	0.388 (0.000***)	0.494 (0.000***)
Fpo	0.509 (0.000***)	0.431 (0.000***)	0.651 (0.000***)	0.425 (0.000***)	1 (0.000***)	0.675 (0.000***)	0.58 (0.000***)
Ii	0.572 (0.000***)	0.482 (0.000***)	0.603 (0.000***)	0.388 (0.000***)	0.675 (0.000***)	1 (0.000***)	0.661 (0.000***)
Gdpw	0.62 (0.000***)	0.603 (0.000***)	0.56 (0.000***)	0.494 (0.000***)	0.58 (0.000***)	0.661 (0.000***)	1 (0.000***)

Note: ***, **, * represent 1%, 5%, and 10% significance levels, respectively.

Table 6 | Results of regression analysis

	Non-standardized Coefficient		Standardized Coefficient	t	P	VIF	R^2	Adjust R^2	F
	B	Standard Error	Beta						
Constant	-71.081	6.949	-	-10.228	0.000***	-			
St	6.977	2.196	0.143	3.177	0.002***	2.302			
Fc	11.067	2.035	0.227	5.438	0.000***	1.985			
Rl	5.394	2.178	0.104	2.477	0.014**	1.991	0.6	0.595	F=113.925 P=0.000***
As	6.617	1.468	0.156	4.507	0.000***	1.366			
Fpo	0.195	0.112	0.078	1.731	0.084*	2.297			
Ii	13.384	2.024	0.294	6.614	0.000***	2.253			
Dependent variable: Gdpw									

Note: ***, **, * represent 1%, 5%, and 10% significance levels, respectively.

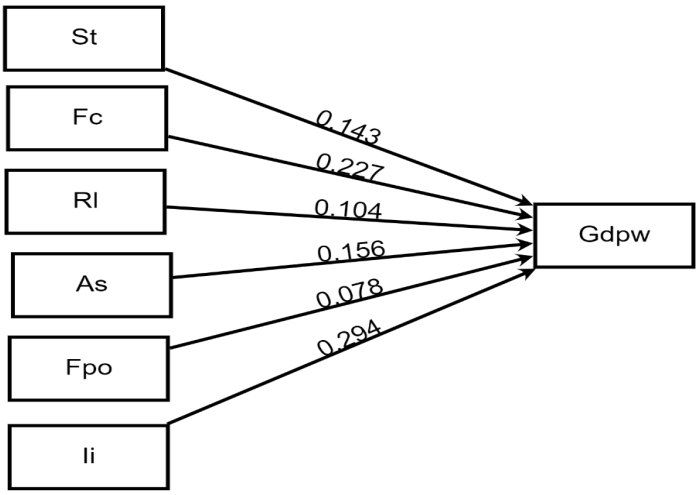

Figure 3 | Regression analysis path diagram

In terms of the overall fit of the model, the R^2 value is 0.6, and the adjusted R^2 value is 0.595, indicating that the model is able to explain about 59.5% of the variance in the grassroots' willingness to participate in democracy. The F-value is 113.925, and the P-value is less than 0.001 (***), indicating that the model as a whole is highly statistically significant. Figure 3 shows the path of the regression analysis results.

The results of regression analysis show that there is a significant positive correlation between space siting, functional comprehensiveness and grassroots' willingness to participate in democracy, indicating that H1 is valid. There is a significant positive correlation between representative level, actor synergies, feedback of public opinion and grassroots' willingness to participate in democracy, indicating that H2 is valid. There is a significant positive correlation between interoperability of information and grassroots' willingness to participate in democracy, indicating that H3 is valid. It should be pointed out that the significance of the three variables of space siting, representative level, and feedback of public opinion is relatively low compared with that of functional comprehensiveness, actor synergies, and interoperability of information.

Considering the influence of the establishment time and distribution area of NPC deputies' contact stations on the number of times of receiving voters, the regression analysis is conducted again by adding the two control variables of establishment time and distribution area to the above six explanatory variables, and the results are shown in Table 7.The regression model with the addition of the control variables shows a higher explanatory strength, with an adjusted R^2 of 0.6, which indicates that the model is good enough to predict 60% of the variation of the dependent variable. The F statistic is significant, which further validates the statistical significance of the model. significant further validates the statistical significance of the model.

In addition, the variance inflation factors of each variable did not show serious multicollinearity problems, ensuring the reliability of the regression results. As can be seen from Table 7, there are significant positive correlations between the six independent variables of space siting, functional comprehensiveness, representative level, actor synergies, feedback of public opinion and interoperability of information and the willingness to participate in grassroots democracy.

4.5. Weighting Analysis

In analyzing the weights of the indicators using the entropy weighting method, the results obtained reveal the

Table 7 | Results of regression analysis with the addition of control variables

	Non-standardized Coefficient		Standardized Coefficient	t	P	VIF	R^2	Adjust R^2	F
	B	Standard Error	B						
Constant	-70.45	6.917	-	-10.185	0.000***	-			
St	8.118	2.189	0.165	3.709	0.006***	2.307			
Fc	9.347	2.02	0.191	4.628	0.000***	1.968			
Rl	6.059	2.176	0.115	2.785	0.012**	1.994			
As	6.388	1.45	0.15	4.405	0.000***	1.357	0.605	0.6	F=112.288 P=0.000***
Fpo	0.201	0.109	0.08	1.838	0.067*	2.228			
Ii	13.189	1.978	0.289	6.668	0.000***	2.181			
Et	4.975	2.203	0.096	2.259	0.024***	2.201			
Da	0.375	2.286	0.002	0.254	0.012*	1.738			
Dependent variable: Gdpw									

Note: ***, **, * represent 1%, 5%, and 10% significance levels, respectively.

relative importance of each assessment item in the overall evaluation system. The information entropy value e reflects the degree of uniformity in the distribution of the indicator data, and the closer its value is to 1, the less information redundancy, i.e., the less variability among the data, the less the indicator can provide. On the contrary, the information utility value d (usually calculated as the information entropy value e) reflects the effective role played by the indicator in decision-making, and the larger the value of d, the higher the contribution of the indicator in the evaluation. Table 8 demonstrates the results of weight calculation of entropy weighting method.

The results of weight calculation of entropy weight method show that the weight of St is 10.981%, the weight of Fc is 12.484%, the weight of Rl is 15.113%, the weight of As is 18.57%, the weight of Fpo is 27.105%, and the weight of Ii is 15.747%, where the maximum value of the weight of the indicator is Fpo (27.105%), and the minimum is the weight of the indicator St (10.981%).To visualize the results, Figure 4 shows the significance of the indicators in the form of a ring diagram.

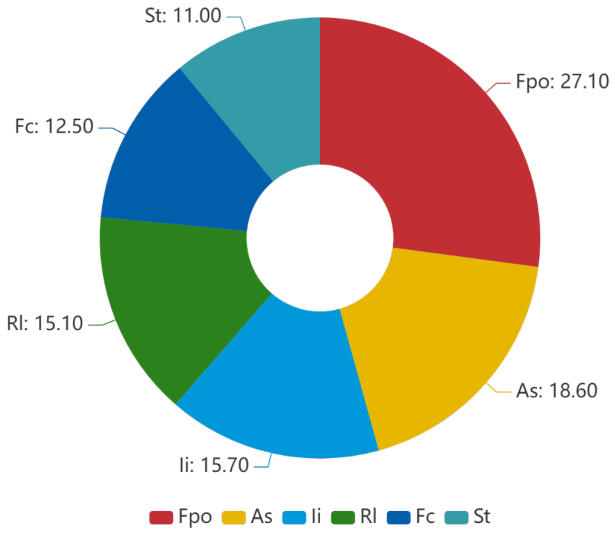

Figure 4 | Weighted ring diagrams for each variable

Table 8 | Results of weighting analysis

Term	Value e	Value d	Weighting (%)
St	0.98	0.02	10.981
Fc	0.977	0.023	12.484
Rl	0.973	0.027	15.113
As	0.966	0.034	18.57
Fpo	0.951	0.049	27.105
Ii	0.971	0.029	15.747

4.6. Robustness Testing

In order to test the robustness of the findings, this study uses the following methods for further empirical testing, and the results can be seen in Table 9. (1) Replacing the regression algorithm as Ridge, the results are shown in Column 1. (2) Introducing stepwise regression to test the correlation between the explained variables and explanatory variables, the results are shown in column 2.

As can be seen from Column 1, the overall goodness of fit of the regression model is high, with an R^2 value of 0.601 and an adjusted R^2 value of 0.592, indicating that the independent variables are able to explain about 59% of the variability in the dependent variable. All the explanatory variables show statistically significant effects on the explained variables. The F-statistic is 112.516 with a p-value of less than 0.000***, which strongly rejects the original hypothesis that the coefficients of all the independent variables are zero at the same time, suggesting that the model as a whole is significant.

The results of the model in Column 2 show that all the included independent variables are statistically significant (P<0.01 or P<0.0), indicating a significant prediction of Gdpw, and that the t-values of all the independent variables are greater than the critical value (corresponding to a significance level of P<0.01 or P<0.001), with a P-value of less than 0.01 (or 0.001), indicating that the coefficients of the respective variables are statistically highly significant, i.e., the respective variables are reliable for Gdpw. R^2 and Adjusted R^2 denote the degree of model fit and explanatory power of the data, respectively. r^2 of 0.597 indicates that the model is able to explain 59.7% of the total variance in Gdpw, while Adjusted R^2 of 0.593 takes into account the effect of the number of independent variables on the explanatory power of the model, and the two are not very different from each other, which suggests that the model has a good fit and explanatory power.

Overall, the results of the robustness test proved the robustness of the previous findings.

Table 9 | Results of robustness test

	1	2
Constant	0.000***	0.000***
	(-9.777)	(-11.266)
St	0.000***	0.001***
	(5.262)	(3.352)
Fc	0.001***	0.000***
	(7.006)	(5.437)
Rl	0.000***	0.001***
	(3.887)	(3.32)
As	0.000***	0.000***
	(5.251)	(4.728)
Fpo	0.001***	0.004***
	(3.481)	(3.541)
Ii	0.000***	0.000***
	(8.152)	(7.863)
Control Variables	included in	included in
R^2	0.601	0.597
Adjust R^2	0.592	0.593
F	F=112.516, P=0.000***	F=135.518, P=0.000***
Dependent variable: Gdpw		

Note: ***, **, * represent 1%, 5%, and 10% significance levels, respectively. The value of t is in parentheses.

5. Conclusion and Discussion

Based on the analysis of data from 185 NPC deputies' contact stations in Xinxiang City, China, the following conclusions are drawn with regard to the empirical influence of spatial elements on the willingness of grass-roots democratic participation.

a. There is a significant positive correlation between the degree of perfection of physical space conditions and the willingness of grassroots democratic participation, and the closer the spatial location is to the concentrated area of residents and the more comprehensive the spatial functions are, the better the performance of the willingness of grassroots democratic participation is, which confirms H1.
b. There is a significant positive correlation between the degree of perfection of interaction space conditions and the willingness of democratic participation at the grassroots level, the richer the level of representation, the stronger the ability of subject synergy and feedback of public opinion, the better the performance of the willingness of democratic participation at the grassroots level, which confirms H2.
c. There is a significant positive correlation between the degree of perfection of digital space conditions and the willingness of grassroots democratic participation, the higher the degree of information interoperability in digital space, the better the performance of grassroots democratic participation willingness, which confirms H3.

The value of these findings compared to the established literature lies in the following. To the best of our knowledge, the effects of different forms of spatial conditions on democratic participation have been studied previously, but empirical testing of empirical evidence is lacking. In addition, examining physical, interactional, and digital spaces within the same physical object helps to identify the combined effects of these spatial conditions on the willingness of grassroots democratic participation.

This study provides academic support for understanding the democratic participation perspective of the widely promoted NPC deputies' contact stations construction in China. China's democracy has its own institutional characteristics and operational practices. The system of people's congresses, as China's fundamental political system, has explored in practice the grass-roots democracy model of NPC deputies' contact stations. Judging from the importance the Chinese government attaches to it and the function it plays in the actual political process, the NPC deputies' contact stations will play an even greater role in promoting the development of democracy in China. However, in terms of academic research attention, there has not been sufficient investigation and research on NPC deputies' contact stations, either in the Chinese or international academic community. This study provides a microcosmic window into understanding China's democratic institutional system. As a matter of fact, China has a rich variety of grassroots democratic spaces. In addition to NPC deputies' contact stations, community comprehensive governance centers, party service centers, and homes for CPPCC members are also carriers of democratic practices with Chinese characteristics. Future research can examine many issues of democratic politics in China with regard to the construction practices of these spaces.

In addition, we would like to develop some discussions from the perspective of the study of democratic politics as a discipline, and these discussions will start from space. Space and time constitute two fundamental dimensions of democratic political practice. As an interdisciplinary research field that combines the theories and methods of geography, political science, economics, history and other disciplines, spatial research involves both macro-level issues such as interstate political behavior, spatial strategy, administrative planning, urban and regional spatial planning and governance, as well as micro-level issues such as relational structure, scenario planning, and scale reconfiguration under specific spaces. In the study of political science, how to combine the theoretical knowledge and concerns of traditional disciplines with the spatial dimension to form a new theoretical perspective is of great theoretical and practical significance for deepening the understanding of relevant socio-political phenomena and issues.

This study examines the factors influencing the willingness to participate in grassroots democracy from the spatial dimension, which is also a preliminary exploration based on the above understanding. With the help of spatial analysis, it can be seen more clearly that democratic participation relies not only on institutional forms and policy promotion, but also on more specific factors such as places and facilities, the creation of situations and the application of technology. For a particular grassroots unit, institutions and policies are given conditions, but how to improve spatial conditions in practice to provide positive conditions for democratic participation should be a more crucial part of grassroots democratic practice.

Author Contributions

Conceptualization, H.W. and K.A.; methodology, C.L.; software, H.W.; validation, H.W., K.A. and C.L.; formal analysis, H.W.; investigation, H.W. and K.A.; resources, C.L.; data curation, H.W.; writing—original draft preparation, H.W., K.A. and C.L.; visualization, H.W. and K.A.; supervision, K.A. and C.L.; project administration, H.W. and C.L.; funding acquisition, K.A. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

Notes

1. This expression is from Chinese President Xi Jinping's speech at the Working Conference of the Central People's Congress. The speech was published in Issue No. 5, 2022, of the journal Qiushi.
2. The establishment of “NPC deputies' contact stations” in China can be traced back to the “NPC Deputies Workstation” that was gradually explored and set up in the Moon Bay Community of Nanshan Street, Nanshan District, Shenzhen City, in 2002. As the NPC deputies played a positive role in the mediation of social conflicts triggered by the relocation of factories at that time, Nanshan Street immediately set up a liaison offi-

cer of the NPC deputies, responsible for regular contact between the NPC deputies and their constituents, and the first "NPC deputies' workstations" were set up in the community in 2005, which was changed to "deputies' liaison stations" in 2005. Subsequently, this practical model of setting up NPC deputies' contact stations in streets and communities was extended to other regions of China, and has become an important vehicle for realizing democratic participation in the era of "people's democracy throughout the entire process".

3. At present, the construction of liaison stations for NPC deputies in all parts of China is carried out on the basis of the guiding opinions issued by the Standing Committee of the NPC at the local provincial level, on the basis of which the People's Congresses of the prefectural-level municipalities usually issue more specific opinions. According to our understanding, the guiding opinions of prefectural-level municipal people's congresses generally require that each township and street set up at least one NPC deputies' contact station, and that the head of the liaison station for township (street) deputies is generally the chairman of the NPC or the director of the NPC working committee.
4. In the selection of contact stations for NPC deputies, the following principles are followed: (1) to take into account NPC deputies' contact stations in different areas, including those in urban communities and those in rural areas of townships and villages. (2) Taking into account different types of contact stations, including those that were established earlier and created star contact stations, as well as those that have been newly established in recent years.

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