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Research Article

A Comparative Analysis of Climate Change Risk Response Perception Paths between Northern and Southern Shaanxi

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ABSTRACT

The public's awareness of climate change risks is the basis for their choice of adaptation action. A good understanding of the key factors that affect the public's perception of climate change risk is critical to climate change risk management. In this paper, a path model was constructed to analyze the path of climate change risk response perception in northern Shaanxi based on 1660 public survey data in northern Shaanxi, which was compared with that of southern Shaanxi. The results showed that (1) there are three causal paths in northern Shaanxi, that is, the public's awareness of climate change issues, awareness of ecological stability, and awareness of climate change causes, to affect response status; there are nine causal paths in southern Shaanxi. (2) There are four related routes in northern Shaanxi and 19 in southern Shaanxi. In short, compared with southern Shaanxi, there are fewer perception paths and simpler models for climate change risk response in northern Shaanxi. (3) The degree of concern for climate change issues and the perception of the causes of climate change influence the establishment of the causal path of climate change risk perception in northern Shaanxi. The major factors that influence climate change risk response perception in southern Shaanxi are climate change risk reason perception, industrial structure adjustment perception, and energy conservation, and emission reduction perception. (4) The response perception path in northern Shaanxi is simpler than that in southern Shaanxi, and there are fewer causal and related paths that impact climate change risk response perception. (5) Finally, through the comparative analysis of the path of climate change risk response perception in northern Shaanxi and southern Shaanxi, this paper provides a reference for coping with climate change risks in northern and southern Shaanxi.

1. INTRODUCTION

The fifth report of the IPCC pointed out that extreme weather and climate events have changed since 1950, and extreme climates have also occurred frequently [1]. In the context of global climate change [2], meteorological disasters occur frequently and the risks of climate change are increasing. It is thus necessary to step up efforts to address the risks of climate change. Currently, there are three main ways to deal with climate change risks: mitigation, adaptation and avoidance [3]. The adaptation challenge grows with the magnitude and the rate of climate change. Even the most effective climate change mitigation through reduction of Greenhouse Gas emissions or enhanced removal of these gases from the atmosphere (through carbon sinks) would not prevent further climate change impacts [4], making the need for adaptation unavoidable [5]. Climate change mitigation consists of actions to limit the magnitude or rate of global warming and its related effects [6]. The main challenge is move away from coal, oil and gas and replace these fossil fuels with clean energy sources [7]. As for avoiding dangerous climate change, a study published in 2018 points at a threshold at which temperatures could rise to 4° or 5° through self-reinforcing feedbacks in the climate system, suggesting it is below the 2° temperature target [8]. Therefore, different climate change risk response methods have certain challenges and shortcomings. And in the interaction between people and the environment, the perception of environment is the main basis for human decision-making behavior [9]. Therefore, it is necessary to explore the formation mechanism of people's climate change risk response perception, so as to overcome the difficulties and shortcomings in climate change risk response.

Most scholars believed that behaviors influencing people's response to climate change risks are diverse. In many instances, there are many factors that cam enhance people's ability to cope with climate change. These factors can include resources, education and information, gender, poverty, wealth, infrastructure, institutional efficiency as well as local indigenous practices, knowledge, and experiences [10,11]. Therefore, factors that influence climate change risk response are diverse. Owing to the interaction between behavior and perception. It is believed that the factors that impact climate change risk response perception are also diverse. This shows that structural equation model is suitable to deal with multiple factors affecting climate change risk response perception simultaneously. In this regard, some scholars have done extensive research.

Momtaz et al. investigated the factors affecting perception and adaptation behavior of farmers in response to climatic changes in Hamedan. The findings indicated that knowledge, perception, and

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belief had the maximum impact on the adaptation behavior, with path coefficients of, respectively, 0.53, 0.32, and 0.18, whereas belief and knowledge had the maximum impact on perception, with path coefficients of 0.56 and 0.35 respectively [12]. Xue et al. [13] pointed out In exploring new ecological paradigms and coping with climate change in China, highly educated respondents showed a significantly stronger path between risk perception and behavior than less educated respondents. Eriksson examined appraisals of threat (cognitive and emotional), personal resources (cost and self-efficacy), and strategies (response-efficacy) as predictors of proactive management responses (past behavior and future intention) among forest owners in Sweden by means of a questionnaire (n = 1482), and found that threat appraisals and response-efficacy are direct predictors of past risk management behavior and the intention to respond in the future [14]. Brown et al. studied the impact of Cyclone Evan in December 2012 on Fijian households' risk attitudes and subjective expectations about the likelihood and severity of natural disasters over the next 20 years, and pointed out the main factors that influence the perception of climate change risk response. Their results showed that extreme event substantially changes individuals' risk perceptions as well as their beliefs about the frequency and magnitude of future shocks [15]. In summary, most scholars believed that education, knowledge, experience and concepts are important in the perception path of climate change risk response.

However, few have incorporated environmental and experiences factors into the climate change risk response perception path model at the same time. In fact, some have conducted research on the factors that influence climate change risk response perception from the perspectives of environment or experience. Marlon et al. analyzed a representative statewide survey of Floridians and compared their risk perceptions of 5-year trends in climate change with local weather station data from the 5 years preceding the survey. Their research compared to local experience, risk perceptions of climate change were more strongly predicted by subjective experiences of environmental change, personal beliefs about climate change, and political ideology [16]. Retchless used an interactive map of sea level rise in Sarasota, Florida and an accompanying online survey, it considers how college students from nearby and far away from Sarasota, and with different views about climate change, vary in their risk perceptions. The results showed that, consistent with spatial optimism bias, risk perceptions increased more from pre- to post-map for respondents far away from Sarasota than for those nearby [17].

Nowadays, although domestic and foreign studies have achieved certain progress in the public's climate change risk perception and its influencing factors, there are still the following shortcomings. First, most of the research subjects focused on investigating the single relationship between environment or experience and response perception, but failed to combine the two to systematically reflect the interaction between various factors and the impact mechanism of climate change risk response perception. Moreover, the research was mostly conducted based on the opinions of peasants. Northern Shaanxi and southern Shaanxi are important geographic regions in China, with relatively frequent meteorological disasters. Comparing the research results of northern Shaanxi with southern Shaanxi can further highlight the perception path of climate change risk response in northern Shaanxi, and provide a typical reference case for risk management and response. Therefore, based on the structural equation model, this paper explored the path of climate change risk response perception in northern Shaanxi and conducted a comparative analysis with southern Shaanxi. This paper attempted to find the answers to the following questions: (1) How many paths are there to respond to climate change risk perception in northern Shaanxi and southern Shaanxi? How does it impact on people's climate change risk response perceptions? (2) What reference can this regular pattern provide for people in northern and southern Shaanxi to deal with the risk of climate change?

2. MATERIALS AND METHODS

2.1. Study Area

Northern Shaanxi is located in the northern part of Shaanxi Province, between 107°28′ and 111°15′ east longitude, and between 35°21′ and 39°34′ north latitude (Figure 1). The loess hilly and gully area of northern Shaanxi is in the middle reaches of the Yellow River and the northern part of the Loess Plateau [18]. It borders Gansu Province and Ningxia Hui Autonomous Region in the west. It is adjacent to the Inner Mongolia Autonomous Region in the north and Fu county, Luochuan and Yichuan counties in Yan'an City in the south, covering 12 counties (districts) including Yuyang District and Dingbian County in Yulin City, and Pagoda District, Ansai County, Zichang County, Yanchuan County, Yanchang County, Ganquan County, Zhidan County, and Wuqi County in Yan'an [19]. Northern Shaanxi consists of two regions, Yan'an and Yulin. The former is a typical dry farming area, and the latter belongs to the agro-pastoral zone in the northern area of China. There are many meteorological disasters in the whole northern Shaanxi region. Drought, frost, rainstorm, gale, hail of varying degrees occur almost every year, among which drought, hail and frost are particularly serious [20].

The south of Shaanxi is close to the Qinling Mountains in the north, and the Bashan Mountain in the south, with Han River flowing from its west to east. The natural conditions of Hanzhong and Ankang in southern Shaanxi have typical characteristics of the southern region. They are located at 105°30′–110°01′E and between 31°42′ and 34°24′N, as shown in Figure 1. They have a humid climate in the northern subtropical zone, and most of mountains have a warm temperate humid climate. The shallow valleys in southern Shaanxi are the warmest areas in the province, with temperatures mostly

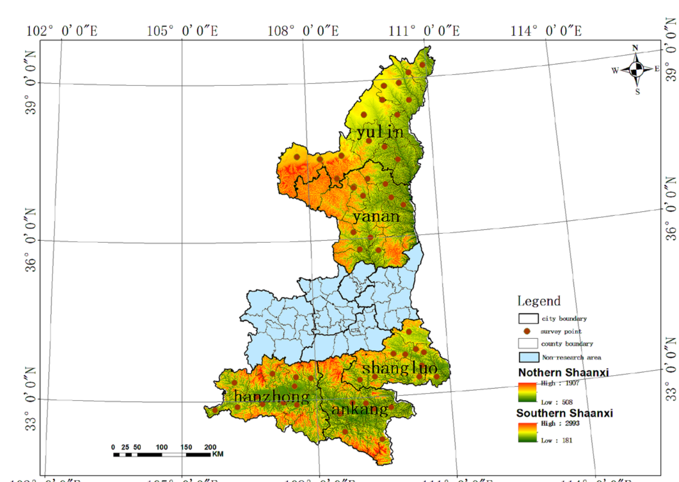

Figure 1 | Topography and geomorphology of the study area.

ranging from 14 to 15°C. The average temperature in January, the coldest month, is 0–3°C, and the average temperature of July, the hottest month, is 24–27.5°C. The annual precipitation is 700–900 mm. There are many flood disasters in southern Shaanxi, and the rainy season is in the autumn, which generally lasts from early and late to mid-early September. The main meteorological disasters there are summer drought, heavy rain, continuous rain, hail, frost, strong wind, cold wave etc. [20].

2.2. Data Sources

The questionnaire data came from a random sampling of public in northern Shaanxi. A total of 1660 valid questionnaires were received, and the response rate was 80%. Among the respondents, 829 were male, accounting for 49% of the total, and 831 were female, accounting for 51% 412 were at the age of 20 or below, accounting for 24.8% of the total; 629 aged 21–30, accounting for 37.9%, and 248 aged 31–40, accounting for 14.9% [21]. There were 186 respondents aged 41–50, accounting for 11.2% [21], 168 aged 51–70, accounting for 10.1%, and 24 aged over 70, accounting for 1.4%. In this survey, the data of the Shaanxi Provincial.

Statistical Yearbook (2018) were used in the design of the population structure of the respondents, and appropriate adjustments were made based on the status of Yan'an and Yulin and large sample requirements. It is for us to consider the representativeness and validity of the sample as much as possible. Table 1 shows other basic characteristics of the surveyed public [22].

The correlation coefficients between the perception of environment beauty and the living environment and risk concepts in northern Shaanxi are 0.435 and 0.238 respectively, which are both significant at the level of 0.01. The correlation coefficient between risk perception and perception of environmental stability is 0.174. The correlation coefficients of the degree of concern for climate change issues with the perception of response situations and the perception of climate change causes are 0.245 and 0.149 respectively (Table 2), both significant at the level of 0.01. Therefore, the questionnaire indicators selected in northern Shaanxi have a relatively significant correlation, which indicates that the public's perception of climate change risks and response paths, and the content validity is high [24].

Table 1 | Basic characteristics of the surveyed public [22]

Survey item	Category	Frequency	Ratio (%)
Education	Elementary school or below [23]	408	29.30
	Junior high school [23]	284	17.10
	High school [23]/Technical secondary school	60	3.60
	Undergraduate/Junior college [23]	278	16.70
	Postgraduate and above	553	33.30
Monthly income	500 and below	870	52.40
	500–1000	292	17.50
	1001–2000	205	12.30
	2001–3000	179	10.70
	3001–5000	114	6.90
Profession	Agriculture, forestry, animal husbandry and fishery	229	13.70
	Production and transportation	53	3.1
	Business services	177	10.1
	Government institutions	28	1.6
	Expertise	173	10.4
	Doctors	135	8.5
	Teachers	557	33.5
	Soldiers	132	7.9
	Self-employed people	99	5.9
	Students	33	1.9

2.3. Research Methods

2.3.1. Construction of structural equation model

Based on the field survey in northern Shaanxi and the analysis of the validity of the questionnaire [25], this paper proposes the following hypotheses, and constructs a path model of the role of risk concepts, living environment, and climate change information mastery on public climate change risk perception (Figure 2).

Hypothesis H1: The public's perception of climate change issues, perception of environmental stability, and perception of the causes of climate change affect the response status [26].

Hypothesis H2: Risk perceptions are positively correlated with the perception of living environment and environment beauty perception.

Hypothesis H3: The living environment and the perception of environment beauty perception are positively correlated.

Hypothesis H4: The degree of concern for climate change issues is positively correlated with the perception of the causes of climate change [27] (Table 3).

Table 2 | KMO value and Bartlett test in northern Shaanxi Kaiser–Meyer–Olkin measures sampling suitability

KMO value and Bartlett test in northern Shaanxi		Kaiser–Meyer–Olkin measures sampling suitability	
Bartlett's sphere test	0.678	Approximately chi-square	1272.646
		df	406
		Significance	0.000

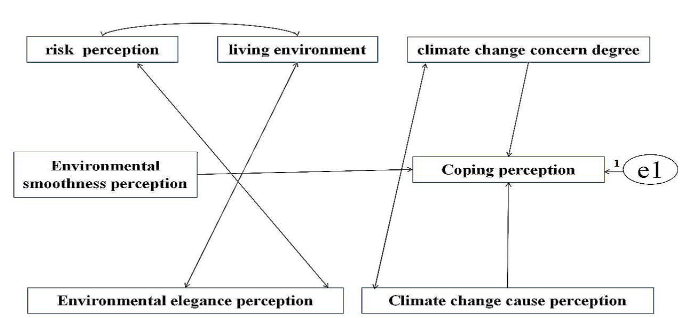

Figure 2 | The impact mechanism model of public climate change risk perception in northern Shaanxi (hypothetical model).

2.3.2. Variable selection and descriptive statistics

Table 4 is the descriptive statistics of independent variables and dependent variables of structural equation model. In addition, it also includes specific questionnaire items corresponding to different indicators.

2.3.3. Path analysis

In order to identify the key factors that affect the perception of climate change risk in southern Shaanxi and the path of these factors, this paper uses path analysis to construct a path map and calculates the effect value (including overall effect, direct effect and indirect effect) in the AMOS26.0 environment [28]. In the structural equation model, the structural model between latent variables with only one observation variable is called path analysis. It is used to test the accuracy and reliability of the hypothetical causal model, the strength of the causal relationship between the measured variables, and it can accommodate the multi-link causal structure and use a path diagram to express it [29]. The basic expression is:

$$\eta = B\eta + \Gamma\xi + \zeta$$

where ξ is the exogenous variable matrix [30], η is the endogenous variable matrix [30], B is the structural coefficient matrix that represents the influence between the constituent factors of the endogenous variable matrix η, Γ is the structural coefficient matrix [31], which represents the influence of the exogenous variable matrix ξ on the endogenous variable matrix η [31], and ζ is the residual matrix which represents the unexplained part [31].

Table 3 Correlation coefficient matrix of climate change risk perception in northern Shaanxi

Index	Understanding the reasons of climate change	Coping situation	Scenic beauty perception	Environmental stability awareness
Living environment	−0.035	0.07	0.435**	0.062
Risk concept	0.01	0.075	0.238**	0.174**
Concern about climate change	0.149**	0.245**	0.069	0.076

**represents significant at the 0.01 level.

3. RESULT ANALYSIS

3.1. Model Fit Test

In AMOS 26.0 environment, path model framework is established and calculated, original path is debugged according to model correction prompts, and the final model of northern Shaanxi is determined (Figure 3).

When response path model freedom degree in northern Shaanxi is 9, its Chi-square value is about 9.312. The corresponding significance

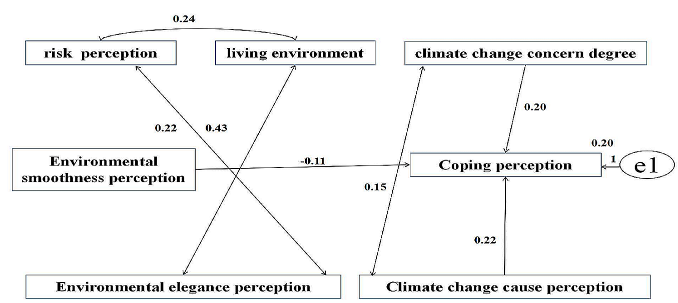

Figure 3 The impact mechanism model of public climate change risk perception in northern Shaanxi (standard model).

Table 4 Description of explanatory variables in northern Shaanxi

Variables	Measurement standard	Assignment	Mean	Standard deviation
Living environment	Regional climate comfort C72	Strongly agree = 1; agree = 2; uncertain = 3; disagree = 4	2.98	1.078
	Severe surrounding pollution C73	strongly disagree = 5; strongly agree = 1; agree = 2; uncertain = 3; disagree = 4; strongly disagree = 5	2.694	1.16
	Regional environmental livability C74	Strongly agree = 1; agree = 2; uncertain = 3; disagree = 4; strongly disagree = 5	2.665	0.983
Risk concept	Risk perception B1	Strongly agree = 1; agree = 2; uncertain = 3; disagree = 4; strongly disagree = 5	3.2	1.86
	Risk option B3	There is 80% chance of getting 4000 yuan, 20% chance of getting nothing = 1, 100% chance of getting 3000 yuan = 2	1.611	0.569
Understanding the causes of climate change	Evaluation of causes of climate change C91	Natural reasons humanistic reasons = 1–7	4.925	2.073
	Understanding the causes of climate change C81, C82, C83	Very well understanding = 1; relatively understanding = 2; general = 3; not very understanding = 4; not at all = 6	2.291	0.861
Concern about climate change issues	Degree of concern for climate change issues D1	Very concerned = 1; more concerned = 2; general = 3; not very concerned = 4; very unconcerned = 5	2.134	0.876
Coping situation awareness	Climate change event participation status D6	Very willing = 1; more willing = 2; unclear = 3; reluctant = 4; very unwilling = 5	1.958	0.967
	Daily coping behavior D7	Always = 1; sometimes = 2; not sure = 3; rarely = 4; never = 5	1.99	1.042
Scenic beauty perception	Scenic beauty recognition C71	Strongly agree = 1; agree = 2; unsure = 3; disagree = 4; strongly disagree = 6	3.112	1.142
Environmental stability awareness	Environmental stability awareness B2	The natural world is fragile, even a small change can cause catastrophic consequences = 2	2.982	0.919
		The natural world is very stable, even if it is greatly disturbed, it can be restored to its original state = 4		

probability p = 0.811 > 0.05, which does not reach the significance level of 0.05. In addition, the ratio of chi-square freedom degree (CMIN/DF) is 0.665 < 2; RMSEA value is 0.000 < 0.050; the GFI, AGFI, IFI, TLI, CFI values are 0.993, 0.985, 1.050, 1.081, and 1.000 respectively, all of which are over 0.900, complying with the standard. The preset model's AIC, BCC, BIC, CAIC, ECVI values are all smaller than those of independent model and saturation model, indicating that the hypothetical model fits well with actual data (Table 5).

3.2. Analysis of Results in Northern Shaanxi

Test results show that the overall effect of climate change reason perception, climate change problems concern degree, public's environmental stability perception and public response status perception is 0.217, 0.200, and −0.18 respectively. Furthermore, the direct effects are 0.217, 0.200, and −0.18, respectively. The direct effects of the degree of concern for climate issues and the perception of the causes of climate change on the situation are significant at the 0.01 level (Figure 3). This shows that the environmental stability perception, climate change reasons perception, and concern degree for climate change issues have a significant positive impact on climate change response perception [32]. It is believed that hypothesis of H1 is valid. In contrast, climate change issues concern degree has a greater impact than the above two (Table 6) [33].

As for correlation path in northern Shaanxi, risk concern is positively correlated with living environment and environment beauty perception, with covariances of 0.137 and 0.203, respectively, assuming H2 holds. Among them, the covariance of risk concepts and living environment, beautiful scenery perception is significant at the level of 0.01, which is inferred to be related to the fragile geographical environment in northern Shaanxi. Further covariance analysis of living environment and scenic beauty perception is 0.362, among which relationship with scenic beauty perception is significant at the level of 0.01, assuming H3 holds. Moreover, the covariance between concern degree of climate change issues and perception of climate change reasons is 0.121, significant at the level of 0.05. Therefore, H4 is confirmed. This shows that the better the living environment in northern Shaanxi, the stronger risk concept and environmental beauty perception. The higher the concern degree of climate change issues, the better the perception of climate change reasons [34] (Table 7).

Table 5 | Index parameters of model adaptation in northern Shaanxi

Evaluation index	Preset model	Saturation model	Independent model
CMIN/DF (Relative chi-square)	0.665		5.12
RMSEA	0		0.107
GFI	0.993	1	0.915
AGFI	0.985		0.887
IFI	1.05	1	0
CFI	1	1	0
TLI	1.081		0
AIC	37.312	56	121.511
BCC	37.947	57.269	121.829
BIC	91.795	164.966	148.753
CAIC	105.795	192.966	155.753
ECVI	0.103	0.155	0.337

Table 6 | Overall effect, direct effect, and indirect effect among variables

Reason variable	Result variable	Overall effect	Direct effect	Indirect effect
Climate change reason perception	Coping situation perception	0.217	0.217	0
Concern degree for climate change problems		0.200	0.200	0
Environmental stability perception		−0.108	−0.108	0

3.3. Comparative Analysis

The path model of public climate change risk response perception in northern Shaanxi was constructed based on risk concepts, living environment, and concern for climate change issues. The climate change risk response path model in southern Shaanxi was constructed based on risk concepts, human and land concepts, cultural level, living environment, and concern degree for climate change issues, and they have all passed test. It is inferred that in northern Shaanxi region, due to the relatively harsh environment, conservative ideological concepts, serious soil erosion, and frequent disasters, education degree has a smaller impact on climate change risk response perception [35]. Instead, concern degree for climate change issues and climate change reason perception influence the causal path of climate change risk perception [36]. In southern Shaanxi, the mountains and rivers are beautiful, so it is less hit by natural disasters. Therefore, climate change result perception, human and land concepts, risk concepts, educational level, and concern degree for climate change issues impact the establishment of climate change risk perception's causal path in southern Shaanxi. In addition, northern Shaanxi is dominated by the secondary industry, whereas southern Shaanxi is dominated by the primary and tertiary industries (Figure 4).

According to research by relevant scholars, the tertiary industry can break through Hu Huanyong line [37], so industrial structure adjustment perception in southern Shaanxi has a significant impact on climate change response perception [26]. From Figures 3 and 4, it can

Table 7 | Climate change risk perception covariance matrix

Variables	Index	Estimate	SE	CR	*p*
Living environment← →	Risk concept	0.137	0.032	4.319	***
Living environment← →	Scenic beauty perception	0.363	0.049	7.424	***
Scenic beauty perception← →	Cimate change reason perception	0.121	0.043	2.787	0.005
Risk concept← →	Scenic beauty perception	0.203	0.050	4.096	*

*, ***represents significant at the 0.05 and 0.001 level.

be seen that there are three causal paths in northern Shaanxi: public's of climate change issues concern degree, environmental stability perception, and climate change reason perception influence climate change response perception. There are nine causal paths in southern Shaanxi, namely, climate change consequences perception, human and land concept [38], cultural level for climate change issues concern degree and industrial structure adjustment perception impact on climate change response status perception; Public human-land and risk concept influence climate change response perception via impact on of climate change reasons perception; human-land and risk concept influence climate change reason perception. As for related routes, there are four in northern Shaanxi and 19 in southern [39]. In short, compared with southern Shaanxi, there are fewer perception paths and simpler models of climate change risk response perception in northern Shaanxi.

3.4. Analysis of Influencing Factors

In order to explore the factors influencing climate change risk response perception in different counties and regions, and to reveal the mechanism of differences in climate change risk response perception path in northern and southern Shaanxi, latitude, longitude and average altitude of each county were taken as independent variables, and climate change risk response perception intensity of each county as dependent variable for linear regression analysis. As shown in Table 8, linear regression model R squared is 0.864, indicating a high fitting degree of model. Further analysis of data in Table 8 shows that latitude and altitude are the most influential factors on climate change risk response perception, with regression coefficients of 0.203 and 0.188 respectively, significant at the levels of 0.01 and 0.05 respectively. This

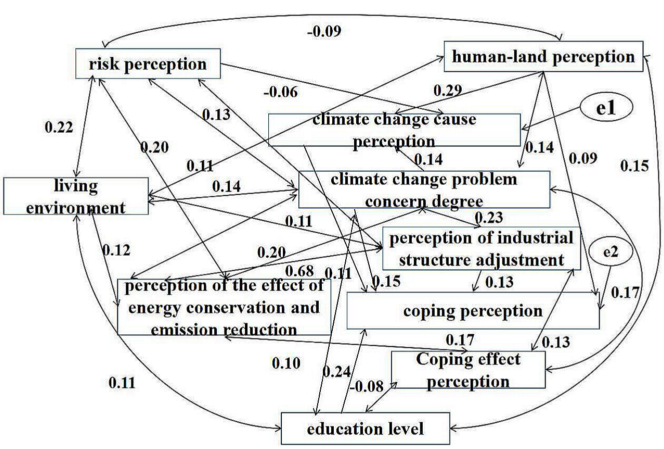

Figure 4 | The impact mechanism model of public climate change risk perception in southern Shaanxi (standard model).

result demonstrates that the greater the differences in terrain and latitude, the greater the difference of climate change risk response perception intensity, which probably leads to difference in paths (Table 8).

4. DISCUSSION

Domestic and foreign studies have also confirmed that the environment and people's experience will influence perception of climate change risk response [40]. For example, Bradley et al. believed that antecedent psychological and socio-demographic variables predict climate change risk perceptions, which lead to enhancing levels of response efficacy and psychological adaptation in relation to climate change, and ultimately to environmentally-relevant behaviors [41]. The study found that: Risk perception (hot), response (both hot and direct) and psychological adaptation (directly) predicted behavior [41]. Smith provided some ground-breaking work on human behavior as it relates to perception and response to risks associated with climate change and climatic variability in the rural communities of Sandy Bay and Fancy. The study examined households' knowledge and perception of the climate change phenomenon and their responses to climate-related events. The results showed that an investigation of responses or the decision to respond to some of the impacts that they have experienced as a result of climate change and climatic variability leads to the development of different types of perceptions, including religious, ill informed, experienced-based, and knowledge-based perceptions. It is argued here that these forms of perception may result in non-adaptive, proactive or reactive adaptive behavior [42]. After studying farmers' response to and perception of climate change risks, Wang et al. [43] believed that extreme climate changes such as rising temperature, decreased precipitation and increased frequency of drought would affect farmers' perception and response to climate change. In the hutt valley, New Zealand et al., through a family survey, as well as seminar and interviews with local government officials, found that flood experience can influence flood risk perceptions, and that flood experience can stimulate increased risk reduction and adaptation actions where climate change risks are likely to occur. It is argued here that these forms of perception may result in non-adaptive or reactive adaptive behavior. These studies have confirmed the rationality of using the two major variables of environment and concept to design the climate change risk response pathway model in northern Shaanxi and southern Shaanxi [44].

To verify the reliability of results of this paper, the climate change risk response perception path model of various cities in northern Shaanxi (Figure 5) and southern Shaanxi (ensure RMSE = 0) is calculated. It is found that climate change risk response perception path of Yulin and Yan'an in northern Shaanxi is much simpler than that in southern Shaanxi (Figure 6). The climate change risk

Table 8 | Linear regression analysis results (n = 24)

Constant	Non-standardized coefficient	Standard error	Normalized coefficient	T	p	VIF	R^2	Adjusted R^2	F
−0.243	–	0.104	–	−2.334	0.030*	–	0.864	0.843	(3,20) = 42.217, p = 0.000
Longitude	0.28	0.173	0.171	1.615	0.122	1.643			
Latitude	0.813	0.203	0.613	4.002	0.001**	3.444			
Altitude	0.42	0.188	0.314	2.24	0.037*	2.887			

Dependent variable: MMS_ganzhi. D-W (Durbin-Watsonstatistic) value: 1.248. $^{*}p < 0.05$, $^{**}p < 0.01$.

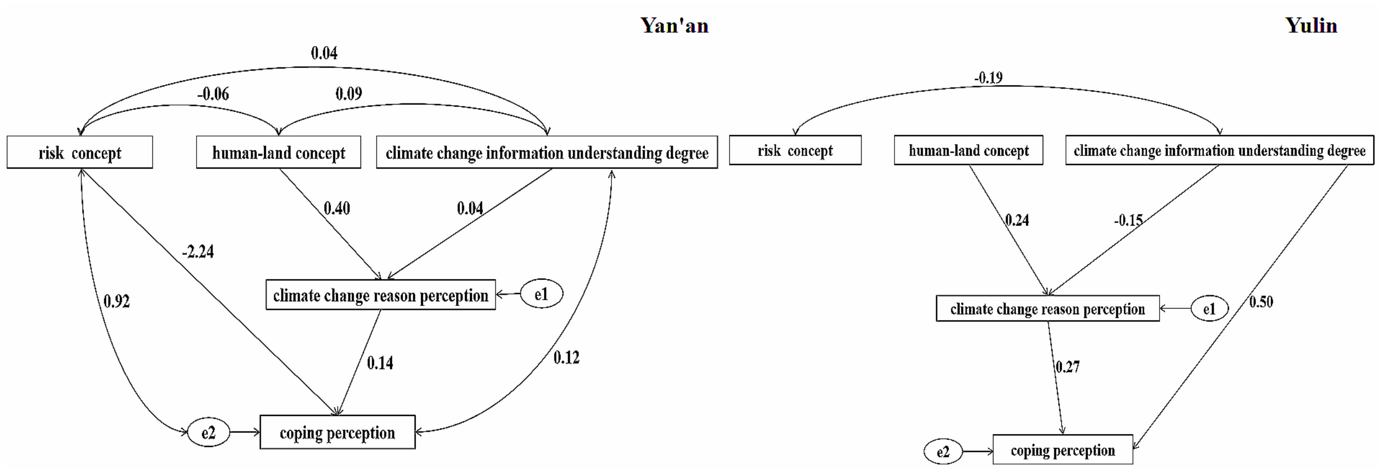

Figure 5 | A perceived path model for climate change risk response of all cities in northern Shaanxi.

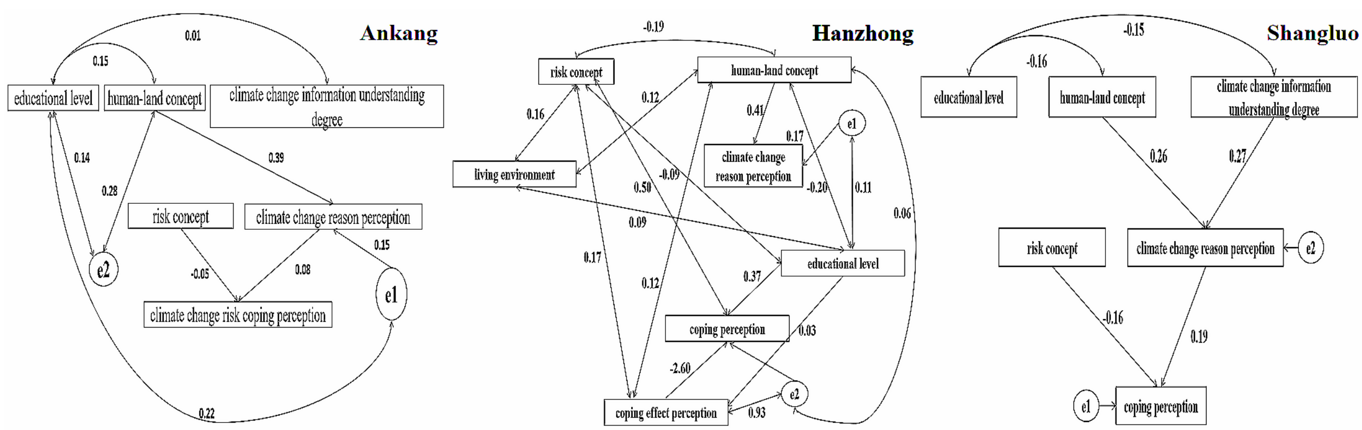

Figure 6 | A perceived path model for climate change risk response of all cities in southern Shaanxi.

response path in northern Shaanxi has four factors included in the model, while southern Shaanxi has at least five. Finally, geographic detectors are utilized to investigate the factors affecting the perception of climate change risk response in northern Shaanxi and southern Shaanxi respectively.

It is found that in northern Shaanxi, the explanatory power of each factor on the perception of climate change risk response is: education level > risk concepts > climate change reason perception > living environment > environmental stability perception > industrial structure adjustment perception > scenic beauty perception = climate change problems perception = energy saving and emission reduction perception, as shown in Figure 7). This shows that impact of industrial structure adjustment, energy conservation and emission reduction perception on climate change risk response perception is not much different from that of environmental stability and grace perception. Thus, the above factors can be substituted for each other, but they cannot be incorporated into the model of climate change risk response perception in northern Shaanxi. This shows that climate change risk response perception path in northern Shaanxi is not a complete mediation model, which is more consistent with the conclusions drawn by Song and Shi [45]. As for the climate change risk response perception paths in southern Shaanxi, most of them are fully intermediary or partial intermediary models, and there is no non-intermediary model (Figure 6). Figure 7 shows the explanatory power of climate change risk response perception factors from small to large. It can be found that energy conservation, emission reduction perception, and industrial structure adjustment in southern Shaanxi have greater explanatory power to climate change risk response perception than environmental stability or beautiful scenery perception. Therefore, it is believed that energy conservation and emission reduction in southern Shaanxi, climate change reasons, and industrial structure adjustment perception are three important intermediary variables that influence their perception of climate change risk response. The view that climate change risk perception path model in southern Shaanxi is more complicated can be empirically proved by Zhou, who demonstrated that public in Hanzhong area influences their perception and response to climate change risks through their perceptions of reasons, knowledge, facts and consequences, which in turn influence their behavior and willingness to climate change risks response [46].

The above discussions indicate that the path of climate change risk response perception in northern Shaanxi is simpler than that in southern Shaanxi, and corresponding influencing factors are also less. The following conclusions can be drawn from the above discussions. First, the main influencing factors of climate change risk response perception in northern Shaanxi [47] are climate change reason perception and climate change issues concern degree. Second, northern Shaanxi region should increase basic network platforms construction to strengthen publicity of climate change risk information. Third, regarding complex perception path in southern Shaanxi to deal with climate change risks [48], people's path of climate change risks response perception is diverse. For this reason, a well understanding of the intermediary variables in climate change risk response perception path model is necessary. Fourth, because industrial structure adjustment, climate change reason perception and climate change problems concern degree are important variables in the climate change risk response perception path model, it is necessary to vigorously promote development of tertiary industry in southern Shaanxi and understanding of climate change risk information and reasons. In terms of demographic factors, education level, monthly income and age in northern Shaanxi have greater explanatory power for climate change risk response perception, and can be considered for inclusion in model in the future. In addition to education level in southern Shaanxi, age also has a greater influence on climate change risk response perception. Therefore, it is necessary to strengthen exploration of age on climate change risk response perception to reduce systematic errors induced by the model. The reasons for the difference in climate change risk response perception path in northern and southern Shaanxi have been well explained in Subsection 3.4. The facts that vertical difference in topography in southern Shaanxi is more significant than in northern Shaanxi, and that they are located in the southern and northern parts of the Qinling Mountains respectively, further confirm that climate change risk response perception in northern Shaanxi is simpler than southern.

The contribution of this paper is mainly reflected in the flowing aspects. First, this paper combines the environment and public experience to explore factors influencing the risk perception of climate change. In addition, the public's perception and experience of risk is divided into two measuring dimensions, which is more innovative than the previous psychology measurement paradigm. Second, this paper, by comparing the two regions of northern Shaanxi and southern Shaanxi, provides a more typical case for public climate change risk management. Finally, most scholars tend to study on people's climate change risk response behavior, whereas this paper directly investigates the path and factors of climate change risk response perception [49], with a better design of the research plan. Nevertheless, it should be pointed out that this research has a small problem in the selection of indicators for the perception of climate change risk response. That is, the indicator of the living environment needs further improvement although it can replace the objective environment where people live. For example, temperature and precipitation can be used to replace the indicator of the living environment. There are less paths in northern Shaanxi than in southern Shaanxi. Previous studies have shown that in the Hanzhong City in southern Shaanxi, age, occupation, education level, income level and public perceptions of climate change knowledge, facts, and reasons perception, perception of consequences, willingness to respond, and response behavior have varying degrees of influence [50]. Therefore, the paths that affect the perception of climate change risk in southern Shaanxi are diverse. Some scholars analyzed the adaptation behaviors and influencing factors of peasants in the hilly loess regions of northern Shaanxi and concluded that peasants' adaptation behaviors are affected by the perception of climate change (Figure 7). In addition [51], family socioeconomic attributes have a significant impact on the probability of peasants' adaptation behaviors, while other attributes such as age and education level are independent of the probability of farmers adopting adaptive behaviors [52] (Figure 8).

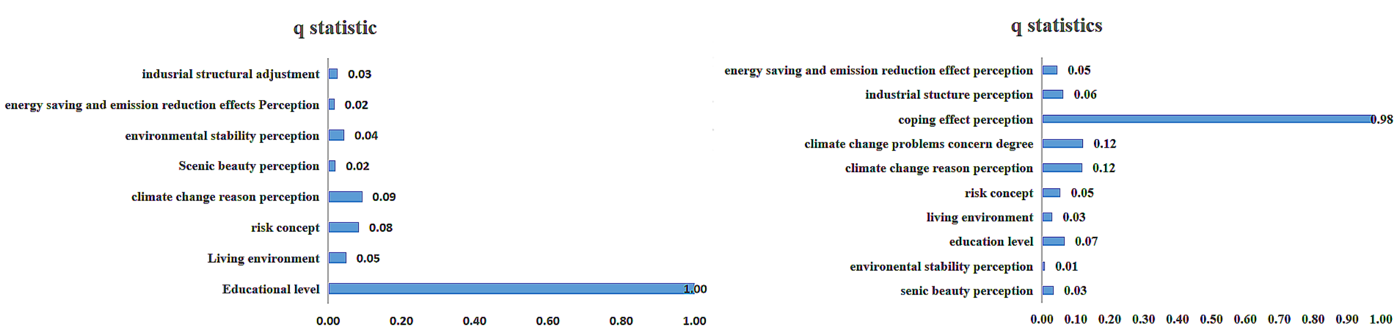

Figure 7 | Detection of impact factors in Shaanxi.

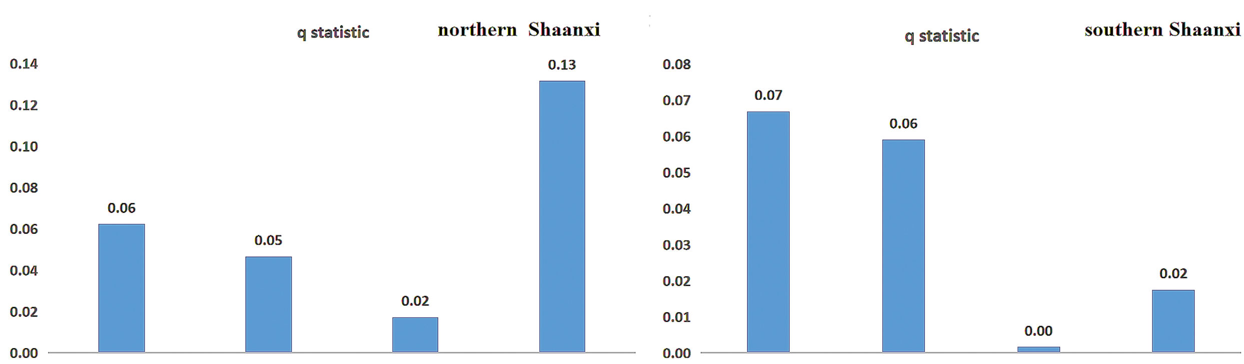

Figure 8 | The explanatory power of demographic factors in Shaanxi.

5. CONCLUSION

Based on the research purpose proposed in the introduction part and the results of the discussion part, the following conclusions can be drawn. Firstly, there are three causal paths in northern Shaanxi, that is, the public's awareness of climate change issues, awareness of ecological stability, and awareness of climate change causes, to affect response status. There are nine causal paths in southern Shaanxi. Secondly, there are four related routes in northern Shaanxi and 19 in southern Shaanxi. In short, compared with southern Shaanxi, there are fewer perception paths and simpler models for climate change risk response in northern Shaanxi. Thirdly, the degree of concern to climate change issues and the perception of climate change causes affect the establishment of the causal path of climate change risk perception in northern Shaanxi. Fourthly, the related paths of climate change risk perception in northern Shaanxi can be summarized into the following two: the better the living environment, the stronger the risk perception of places; the higher the degree of concern for climate change issues, the better the perception of the causes of climate change. Finally, according to the above conclusions, we put forward the following suggestions for northern and southern Shaanxi to deal with the risks of climate change. Northern Shaanxi and southern Shaanxi should be different in managing climate change risk. Northern Shaanxi should strengthen advocacy on the causes of climate change, and southern Shaanxi should strengthen publicity on the effects of climate change risk response and increase adjustment of industrial structure, and at the same time, actively carry out energy conservation and emission reduction activities to promote climate change risk response.

CONFLICTS OF INTEREST

The authors declare they have no conflicts of interest.

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