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# Environmental risks of high-speed railway in China: Public participation, perception and trust



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### ABSTRACT

Two decades ago China entered an era with rapid expansion of transport infrastructure. In an ambitious plan on high-speed railway development, China plans to have the longest high-speed railway network by 2020. Social concerns and anxiety with the adverse environmental and social risks and impacts of high-speed railways are related to the lay-out, the construction and the daily operation of high-speed trains. While anecdotal evidence of concerns and anxieties of Chinese citizens on high-speed railway systems exist, systematic assessment of concerns, anxieties, protests and support of Chinese citizens regarding the planning, implementation and daily operation of high-speed railways is absent. This study investigated high-speed railway related public views, risk perceptions and trust of Chinese residents living along the Beijing-Shanghai high-speed railway. The results show high public acceptance in high-speed railway, due to perceived low environmental and social risk and high economic and social benefits. The current closed, government-dominated decision-making, opaque information provisioning, and lack of communication with and involvement of residents cause low levels of trust in railway-related local governmental agencies and companies. The increasing 'room for manoeuvre' of China's civil society may increase information disclosure and transparency, two-way risk communication and public participation in future large infrastructure development.

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## 1. Introduction

The construction of high-speed railways (HSRs, with 200 km/h) has become an important priority for many countries. A decade ago China entered an era with high investments in and rapid expansion of HSR transport infrastructure. State planning for China's HSR began in the early 1990s. The first HSR (Qinhuangdao–Shenyang) started to construct in 1999 and opened in 2003. In 2004, the State Council approved *Medium and Long-Term Railway Network Plan 2005–2020* and adjusted it in 2008. According to the Plan, the government will build a grid of HSRs with four east-west lines and four north-south lines, also named “four vertical and four horizontal corridors”. The Wenzhou bullet train accident on 23 July 2011 was the first major HSR calamity, killing 40 and seriously injuring 200 people. It spotlighted long-persisting safety fears among many Chinese experts, who called on the government to slow down expansion plans. The Chinese HSR was designed for a maximum speed of 380 km/h in commercial operation, but operational speed was reduced to 200–300 km/h after the Wenzhou train collision. The accident and the prosecution for corruption of top railway officials temporarily slowed down the progress of the country's massive government-operated, funded, and built rail infrastructure. However, by early 2012, the Chinese government renewed investments in high-speed railway to rejuvenate the slowing economy. As of December 2013, China has the world's longest HSR network with 11,000 km of rail in service. By the end of April, 2014, China railway sector raised its 2014 fixed asset investment budget to RMB 800 billion (US\$ 129 billion) and increased the number of HSR projects from 44 to 64. According to the 12th *Five-Year Plan on Railway Development 2011–2015* enacted in July 2011 by the Ministry of Railway (MoR),<sup>1</sup> China is projected to have nearly 40,000 km of operational high-speed railway by 2015 (Fig. 1).

Beijing–Shanghai HSR (*Jinghu* HSR in Chinese) was proposed in the early 1990s by the former MoR and became one of the four north-south railway lines planned in the *Medium and Long-Term Railway Network Plan 2005–2020*. In 1995, the track was included in the 9th Five Year Plan (1996–2000). The MoR submitted an initial high-speed rail line design for state approval in June 1998 ([Net Resources International, 2011](#)). After five years of intensive debate whether to use steel-on-steel rail track or maglev technology, the construction plan was finalized in 2004 and feasibility study report was approved in March 2006. The Beijing–Shanghai High-Speed Railway Corporation was established in 2007 as a responsible agency for project construction. The provincial and municipal governments along the line were responsible for the land acquisition, people moving to new houses, and land clearance within their respective jurisdictions. Construction of the Beijing–Shanghai HSR began on April 18, 2008 and commercial train services started on June 30, 2011. Over 200 million passengers took the Beijing–Shanghai HSR till April, 2014.

According to the MoR, construction included twice as much concrete as the Three Gorges dam, and 120 times the amount of steel used in the Beijing National Stadium. There are 244 bridges and 22 tunnels, and the route is constantly monitored by 321 seismic, 167 wind speed and 50 rainfall sensors ([Railway Gazette International, 2011](#)). Total investment of the Beijing–Shanghai HSR was 217.6 billion Yuan (US\$ 32 billion), in line with other mega infrastructure projects such as the Three Gorges Dam Project, the Qinghai–Tibet Railway, the South-to-North Water Diversion Project, the West-to-East Natural Gas Transmission Project and the West-to-East Power Transmission Project.

More recently and not unlike what happened in other countries, the environmental and health consequences and impacts of China's HSR have moved to the fore in public and policy debates. Researchers in China have reported on the environmental, ecological and health impacts of the high-speed railway, as well as on its economic and social benefits ([Chen et al., 2010, 2007, 2014](#); [Ding et al., 2010](#); [Jiang, 2010](#); [Zhang, 2010](#)). However, these studies mainly concerned scientific environmental impact assessment of the HSR, but ignored public perceptions and evaluations of environmental and health risks. Little is known of these risk perceptions by the public of HSR infrastructure, and the trust of the public in government authorities and railway companies in coping with such risks which are important for decision-making. This research fills the above gap by investigating Chinese residents

<sup>1</sup> March 2013 MoR was split: one part was amalgamated into Ministry of Transport, the other part became the new National Railway Corporation.



Fig. 1. China's High-Speed Railway Construction Plan till 2015.

living along the Beijing–Shanghai high-speed railway in three selected cities. The next section reviews the literature on the environmental concerns and anxieties of citizens on high-speed railway. Section 3 reviews the environmental policies and protests on high speed railways in China, to be followed by an introduction to the research methodology in Section 4. Four subsequent sections report on the public's view on HSR, its perceived risks and benefits, information access and trust of the public, and participation of and communication with the public in decision-making, respectively. The final section presents the conclusions.

## 2. Environmental concerns and anxieties of high-speed railway

There is a vast international literature on the planning, implementation, and day-to-day operation of high-speed railways, predominantly from a technological-engineering, a financial-economic and/or a time-delay perspective (Han et al., 2009; Albalade and Bel, 2012). However, ever since high-speed trains have been planned and implemented (first in Japan in the 1960s and France in the 1980s, later also in Spain, Germany, Italy, UK, US, China, Korea and other countries) a part of the literature addressed the environmental and social impacts that were believed to come along with the construction and operation of these bullet trains. Although high speed in all modes of transport comes at a price of negative environmental impact, many environmentalists, railway companies and their interest organizations, as well as governmental agencies claim that high-speed railway is environmentally friendly compared to road and air transport and can contribute to climate change mitigation. Independent research, on the other hand, concludes that these benefits may not be that large. Over the last decade, many researchers have shown that high-speed railway can affect the surrounding soil, air and water environment, the landscape and ecological system, energy efficiency, and human health,

especially in urban areas and sensitive regions (Chester and Horvath, 2010; Givoni, 2006; Janic, 2003; Kaczensky et al., 2003; Rozycki, 2003; Van Wee et al., 2003; Westin and Käson, 2012).

While overall and on a higher (national) aggregate level, high-speed trains have often (but not always e.g. Spaven, 2006; Chen et al., 2014) been welcomed as environmentally friendly alternatives for road and air transport systems. But locally, along the tracks of the high-speed railway, concerns and protests have been strong in some countries. These environmental concerns, anxieties and protests of (organized) citizens and residents have also been identified as major causes of delay and overspending, following lengthy procedures and additional infrastructure requirements. Hence, controversies on these large-scale public projects have often been interpreted in terms of general and national interests versus specific and local interests (De Carlo, 2006). Local environmental concerns and anxieties have been brought in relation to NIMBYism (Not In My Back Yard), although that is not always considered an adequate interpretation of such concerns (Owens, 2004; Lastrico, 2012).

Concerns and anxieties with adverse environmental and social risks and impacts of high-speed railway are related to both the construction and (also geographical) lay-out of these infrastructural systems, as well as the daily operation of high-speed trains. Citizen and local communities (incidentally backed by local authorities) have protested against, among others: the intrusion by these high-speed tracks of their local communities and identities (Della Porta and Piazza, 2007); significant land-use change and consequences for landscape and biodiversity; top-down planning and design by national authorities with limited or no possibilities for participation and co-decision; and environmental and human health consequences of the daily high-speed train operation, including noise, vibration, radiation and electro-magnetic pollution, visual and air pollution, and accidents. Related to these concerns is the likely devaluation of property, except for property near railway stations. In many countries a majority of local citizens along a (planned) track protested against the planned high-speed railway, while a minority considered the regional economic and social benefits more important than these negative environmental and social risks (Schaap, 1996; Marincioni and Appiotti, 2009; Fedi et al., 2012). Local concerns and anxieties were often paralleled by distrust against (national) planners and decision-makers, construction and railway companies, and even democratic representative institutions (Marincioni and Appiotti, 2009; Lastrico, 2012). Concerns and distrust around high-speed railway plans turned into widespread and massive protests against such infrastructural projects when public opinion was supportive, residents had a strong attachment to their local places, and local community along the track became involved (Marincioni and Appiotti, 2009).

Over the past decade governmental authorities in many countries have learned and partly implemented lessons on how to cope, handle and partly prevent these concerns, protests and distrust of local citizens and communities during the planning, implementation and operation of high-speed railways. Hence, we have seen extensive information provisioning from multiple authorities and also disinterested/independent parties and stakeholders; extensive public consultations (De Carlo, 2006; Marincioni and Appiotti, 2009); systematic and institutionalized involvement of citizens, communities and NGOs in different phases of high-speed railway project planning and implementation; growing experiences with and institutionalisation of environmental dispute resolution; and the development of alternative trajectories and costly adaptations of plans e.g. in the form of tunnels, noise screens and compensation funds. These adaptations have all contributed to less (and less violent) citizen conflicts, protests and concerns on high-speed railway systems. Dorf and Sabel (1998) labeled the various attempts to further involve and engage local citizens beyond the formal representative institutions democratic experimentalism. The French Mediterranean high-speed railway is often cited as a best-practice model in democratic experimentalism, trying out consultative and participatory decision-making (Leheis, 2012; De Carlo, 2006). But also in other European countries consultation, participation, and dispute resolution have increasingly been institutionalized in laws, regulations and policy-making practices. It was not that public concerns, anxieties and protests on high-speed railways and other larger infrastructural project have disappeared in liberal democracies, as examples in South Korea (Han et al., 2009), Germany (Novy and Peters, 2013) and the UK (the recent protest on the HS2 from London to West Midlands) showed. But these concerns, anxieties and protest have certainly been contained, partly addressed and overall diminished through institutionalized forms of public engagement and participation. Such institutional innovations have also increased the legitimacy of national governments in planning and implementing high-speed

railways (Kaufmann et al., 2008). Still, in some cases major distrust and (violent) protest remained among local environmental groups, citizens and even local government officials against national governments and national railway companies; while national NGOs cooperated more smoothly with these national authorities and companies (Marincioni and Appiotti, 2009; Della Porta and Andretta, 2002; De Carlo, 2006).

### 3. Environmental policies and protests on HSR in China

Over the last 20 years, China's government has established a legal system for the environmental management of HSR development and construction. At the plan and construction stages of HSR, "Three Simultaneous" principle (the main project and pollution control facilities have to be designed, constructed and put into use synchronously) and environmental impact assessment (EIA) are prerequisites, according to the 1998 *Regulations on the Administration of Construction Project Environmental Protection* and the 2003 EIA Law. Following the EIA Law, the Ministry of Environmental Protection (MEP) identified the railway sector as one of the pilot sectors, which was included in *The 11th Five-Year Plan on Railway (2006–2010)*. Since 1995, the MoR developed a series of environmental protection regulations, guidelines and standards and the Ministry of Transport enacted *Measures for the Administration of Environmental Protection of Transport Construction Projects* in 2003. In 2007, the MoR also issued a "Six in One" policy, of which environmental protection was one of the six objectives in implementing HSR.

At a practical level, environmental protection measures have been integrated into HSR planning and construction, including rail network planning, pre-feasibility study, feasibility study, preliminary design, construction and operation. However, many challenges emerged. Environmental noncompliance of HSR projects occurs every now and then, and caused public protests and governmental reactions (Yan and Wang, 2012). For instance, between 2010 and 2012 the MEP ordered the temporary suspension of construction and operation of 13 high-speed lines that failed to pass environmental requirements (Liang, 2012; *The Beijing News*, 2011). Problems included inappropriate siting, noise nuisance, radiation effects, non-updated EIA reports, absence of compulsory public participation in EIA, and ecological impacts on the giant panda protection zone (Liang, 2012). The MEP also issued the *Notice on the Changing EIA of Railway Construction Projects* in January 2012, which specified that a second EIA was necessary in case a rail project included major changes in six categories.

Evidence exists of emerging concerns and anxieties of Chinese citizens on high-speed railway systems. In 2008, Shanghai citizens protested against a planned track from Shanghai to south of Hangzhou. In December 2009 Chengdu citizens opposed the planned Chengdu-Chongqing HSR because of noise pollution and electromagnetic effects. A public survey showed that 99.8% of the local citizens objected to the planned route (Lu, 2010). Finally, the construction scheme was adjusted and the construction started in October 2010. The planning of the Beijing-Shenyang HSR project also encountered fierce public debate and objections, especially on noise and safety. Since 2009, tens of thousands of Beijing residents conducted four massive protests that delayed HSR construction. In December 2012, for instance, around 300 protesting citizens criticized a fraudulent EIA report posted online<sup>2</sup> and called on authorities to change the proposed route. Some scholars have identified major challenges for Chinese authorities to disclose information, to organize public participation, and to mitigate social and environmental impacts of HSR (Wang et al., 2012). The emerging public protests against large infrastructural projects resulted in the promulgation of *Interim Measures on the Social Stability Risk Assessment of Major Fixed Assets Investment Projects* by National Development and Reform Commission (NDRC) in August 2012. The NDRC classified all projects as having high, medium, or low risk levels, and only low risk projects could receive approval of NDRC.

Concerns, anxieties and protests of Chinese citizens regarding the planning, implementation and daily operation of high-speed railways have hardly been studied systematically. A number of

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<sup>2</sup> The environmental impact assessment report posted online in November 2012 suggested that 94% of the Beijing residents were in favor of the HSR in July survey.

institutional differences between China on the one hand and European and North American countries on the other hand makes that the results of Western studies on HSR protests and citizen concerns (as cited above) cannot automatically be considered valid for China. First, China is only just starting to experiment with consultation, participation and wide-spread two-way information provision on the environmentally relevant infrastructural projects (Zhong and Mol, 2008; Zhao, 2010; Kostka and Mol, 2013). Hence, the often criticised DAD (Decide-Announcement-Defend) approach to infrastructure policy making still prevails in China. Second, in China room for releasing concerns, anxieties and complaints in (old and new) media and for individual and collective protests is expanding over the last decade, but still of a different magnitude compared to western democracies (Wu, 2013; Johnson, 2013; He et al., 2014b). Third, while in all countries national state agencies play a major role in planning and implementing (but less in operating) high-speed rail systems, in China the role of market parties and local authorities is much smaller compared to European and North American countries. This all has potentially consequences for the credibility and trust relations of citizens around the planning and construction of major infrastructures by state authorities (He et al., 2013). And finally, environmental and health concerns have only recently emerged high on the public and political agendas (He et al., 2012a, 2012b; Xiao et al., 2012).

#### 4. Study area and data collection

We investigated public concerns and trust on China's HSRs through a case study on the Beijing-Shanghai HSR because it was a first long HSR that crossed the developed eastern area and had some citizens opposed its construction. In connecting two major economic zones – the Bohai Economic Rim and the Yangtze River Delta – this track passes through four provinces and three municipalities (Beijing, Tianjin, Hebei, Shandong, Anhui, Jiangsu and Shanghai) and crosses the Yangtze River and Huanghe River. One quarter of the country's population lives along the railway, with a total length of 1318 km. The environmental investment in track construction was 7.69 billion Yuan, accounting for 3.53% of the total investment budget. Reducing the project's short- and long-term eco-environmental consequences have been pivotal elements in the planning, construction and operational phases. Alternative routes were selected in order to protect four historical and cultural heritage sites in Anhui, Jiangsu, and Hebei provinces. Bridges and tunnels were constructed where the HSR passed three scenic areas in Jiangsu and Anhui provinces and engineering measures were taken to protect vegetation and biodiversity. Sound barriers were set up along 326 km for noise reduction.

Problems occurred regardless of these preventive measures. Before construction started, many Shanghai citizens resisted this HSR. In total 9769 Shanghai households within 30 m on both sides of the HSR were moved to new places to avoid major health impacts. During construction, audit reports of the Chinese National Audit Office on Beijing-Shanghai HSR disclosed non-compliance and failure to implement environmental laws and regulations from 2009 to 2011. In June 2012, MEP disclosed environmental monitoring and investigation results of Beijing-Shanghai HSR project, according to *Notice on Implementing Public Notification of Final Environmental Protection Acceptance of Completed Construction Projects 2003*. The noise levels caused by high-speed trains exceeded the national standard in 129 out of 1001 sensitive places of the Beijing-Shanghai HSR (MEP, 2012).

In order to study public attitudes towards environmental risk of this HSR, a stratified sampling strategy was adopted for selecting the cities/prefectures. Tianjin Municipality, Suzhou prefecture (Jiangsu Province), and Zaozhuang prefecture (Shandong Province) were selected as investigation sites from a total of 24 cities along the Beijing-Shanghai HSR (Fig. 2). The criteria for selecting these municipalities/prefectures were diversity in size (including a megacity of 15 million, a large city of six million and a medium-sized prefecture of 3 million inhabitants), economic level (high in the first two prefectures and medium in the last one; but of course compared to overall China all relatively high), and location along the Beijing-Shanghai HSR (north, south, and middle). Two methods for data collection were employed: a series of in-depth interviews with officials of local governments, local Environmental Protection Bureaus (EPBs), and Transportation Bureaus were held; and a survey among 900 residents along the Beijing-Shanghai HSR was executed. Interviewed officials participating in the HSR project coordination were purposefully (rather than randomly) selected with the assistance of



Fig. 2. Three surveyed places along Beijing-Shanghai high-speed railway in China.

local governmental organizations, ensuring their environmental management knowledge and involvement in HSR planning, construction and/or operation. In each of the three cities, an equal number of residents were selected through stratified random sampling, ensuring variety in distinct communities, economic situation, and distance to the HSR. The surveyed residents accounted for 0.01%, 0.02%, and 0.7% of the total population (2012) living along the track in the three districts of Tianjin, Suzhou, and Zaozhuang, respectively. As we present pooled results of the three neighborhoods (and not weighted averages), there is a small bias towards less well-educated and poorer households.

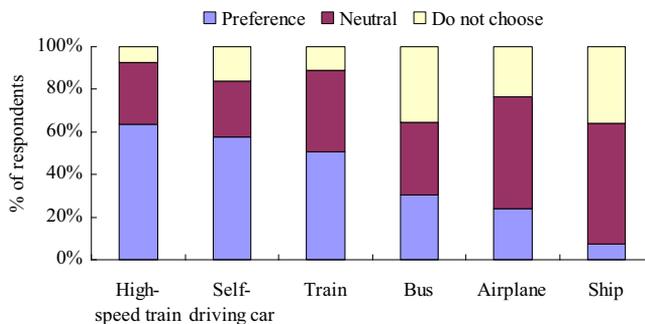
All interviewed officials and surveyed residents were told that information would be made anonymous and only used by the researchers. Semi-structured interviews were executed face-to-face by the first author, recorded through field notes and transcribed. Interview topics were developed in relation to the main research questions, including the viewpoints on HSR construction and operation, perceived environmental and ecological risks, environmental measures and management practices, information disclosure and communication between citizens and HSR public and private organizations. The survey questionnaire on HSR risk perceptions and trust consisted of five sections: (1) socio-demographic characteristics of the interviewees; (2) public experiences and perceptions with high-speed railway; (3) risks and benefits of high-speed railway; (4) information access and public trust in HSR stakeholders; (5) decision-making, public participation and communication. The draft questionnaire design was discussed with five researchers from our institutes and from two local universities, and an adapted version was pre-tested among 20 residents nearby the Beijing-Shanghai HSR in Zaozhuang prefecture in August, 2012, and further adapted. The final revised questionnaire was used by 10 trained interviewers in a face-to-face survey in September and October 2012. A total of 828 valid resident questionnaires were returned (response rate 92%); 288 came from Tianjin Municipality, 271 from Zaozhuang, and 269 from Suzhou. Table 1 provides the background of the pooled respondents. SPSS was used for statistical analysis of the survey data.

## 5. Preference and views on high-speed railway

In line with earlier research (Chen et al., 2014), the high-speed railway is seen as a preferable mode of medium (about 1000 km and less than 5 h traveling) distance transport in China. Almost 60% of the

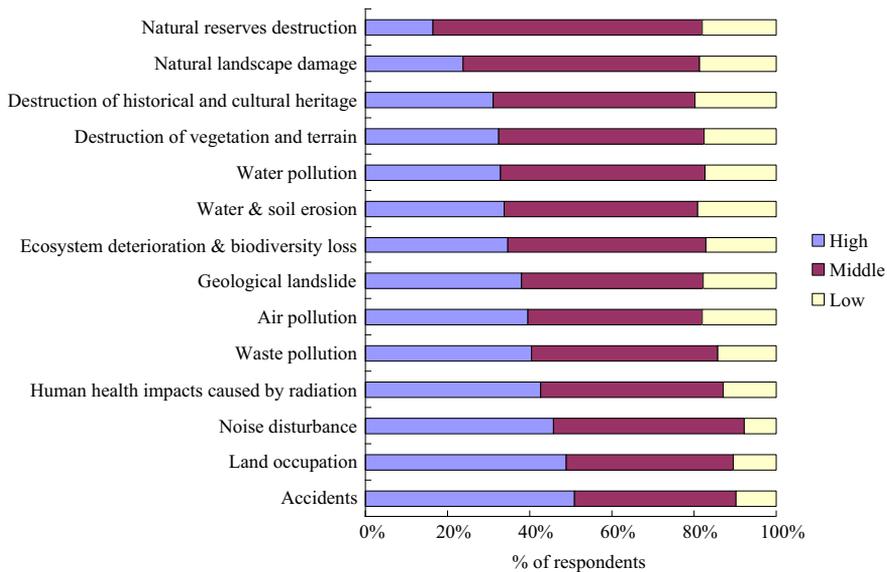
**Table 1**Social and demographic background of respondents in Tianjin, Suzhou, and Zaozhuang ( $n=828$ ).

Items	Sub-group	Percent (%)	Items	Sub-group	Percent (%)
Place	Tianjin	35	Occupation	Teacher, researcher	19
	Suzhou	32		Governmental staff	18
	Zaozhuang	33		Businessman	17
Age	Less than 30	37	Farmer	7	
	31–50	54	Worker	18	
	More than 50	9	Students	13	
Gender	Male	56	Retirement	4	
	Female	44	Other	3	
Party member	Yes	26	Income per month (Yuan)	Less 2000	26
	No	74		2001–4,000	44
Education	Middle school and below	14		4001–6,000	16
	High middle school	36		6001–8,000	6
	College and university	46		8001–10,000	3
	Master and above	4		More than 10,000	5

**Fig. 3.** Respondent preference for long distance transport modes ( $N=828$ ).

respondents have taken the high-speed railway at least one time during the last two years, and see the high-speed railway as their first choice for travels over medium distance. Over 63% of the respondents preferred high-speed railway to other transport modes, such as conventional train, bus, airplane and ship. Only about 7% of the respondents indicated not to choose high-speed railway (Fig. 3). Time saving, comfort, and convenience determined the HSR preference, while high prices and long distances to HSR stations negatively affected HSR preferences. Chi-square tests indicated that males ( $\chi^2=16.029$ ,  $p < 0.001$ ), younger respondents ( $\chi^2=47.628$ ,  $p < 0.000$ ), civil servants ( $\chi^2=81.758$ ,  $p < 0.000$ ), respondents with higher incomes ( $\chi^2=44.767$ ,  $p < 0.002$ ), respondents with previous HSR experience ( $\chi^2=76.891$ ,  $p < 0.000$ ), and respondents from large cities ( $\chi^2=21.547$ ,  $p < 0.001$ ) preferred high-speed railway to females, older citizens, private sector respondents, lower income residents, respondents without previous HSR experience, and citizens from small towns and villages. No statistically significant differences were found with respect to education and party memberships.

The interviewed local officials expressed positive and supportive attitudes towards the construction of the HSR in their jurisdictions. About 38% of the residents supported the construction of HSR nearby their home, 12% opposed it and around 50% were ambivalent. Spearman correlation analysis showed that attitudes towards the construction of high-speed railway were more positive among highly educated ( $p < 0.05$ ), high income residents ( $p < 0.05$ ), those with HSR experience ( $p < 0.001$ ), those living in large cities ( $p < 0.05$ ) and far away from high-speed lines ( $p < 0.01$ ). Sex, age, and party membership had no differences on attitudes towards the construction of high-speed railways in China. In terms of the distance to the HSR, over 90% of the respondents thought it safe to



**Fig. 4.** Respondents' concern about the ecological and environmental impacts of high-speed railway construction and operation ( $N=828$ ).

live at least half a kilometer from the HSR line. The most preferable safe distance was 1–2 km (43%). The majority of respondents felt that the local environment deteriorated compared to three decades ago, in terms of serious environmental pollution (54%), damaged natural landscape (16%), and more and more man-made buildings (11%) due to fast urbanization and industrialisation. The area along the Beijing–Shanghai HSR has industrially developed and became densely populated over the years. Still, after the HSR construction and putting into operation, nearly 39% of the respondents considered that the local environmental quality improved, and only 13% thought it deteriorated. Others did not perceive any changes. About 19% of the respondents still felt they lived in an area with beautiful natural scenery.

Surveys and studies in other countries have reported widespread concerns about the environmental and ecological impacts at construction and operation stages of the HSR (Chester and Horvath, 2010, 2012; De Santo and Smith, 1993; Givoni, 2006; Kaczensky et al., 2003; Rozycki, 2003; Westin and Käason, 2012). The data in the current survey showed similar concerns. Respondents were asked to indicate their concerns about 14 environmental and ecological issues related to high-speed railway construction and operation (Fig. 4). Accidents, land occupation and noise disturbance were of the highest concerns to respondents. The 2011 Wenzhou crash accident, the first of its kind in China, may have had a profound impact on public confidence and concern with high-speed railway in our study, leading especially to major concerns regarding accidents. In general, there were relatively high levels of concern for environmental pollution compared to ecological impacts such as deteriorating natural reserves, landscape damage or cultural heritage destruction (Fig. 4). Hence, Chinese citizens were more concerned about environmental impacts during operation of the services, and less about those related to the construction phase. This contrasted environmental concerns around HSR found in western countries, using similar questions (e.g. Marincioni and Appiotti, 2009).

## 6. Comparing perceived risks and benefits of high-speed railway

Perceived high-speed railway construction and operational risks were compared with other large infrastructure projects (Fig. 5). The results showed that nuclear power, new weapon systems, and large chemical plants were perceived by most respondents as high risk projects (65%, 62%, and 60%,

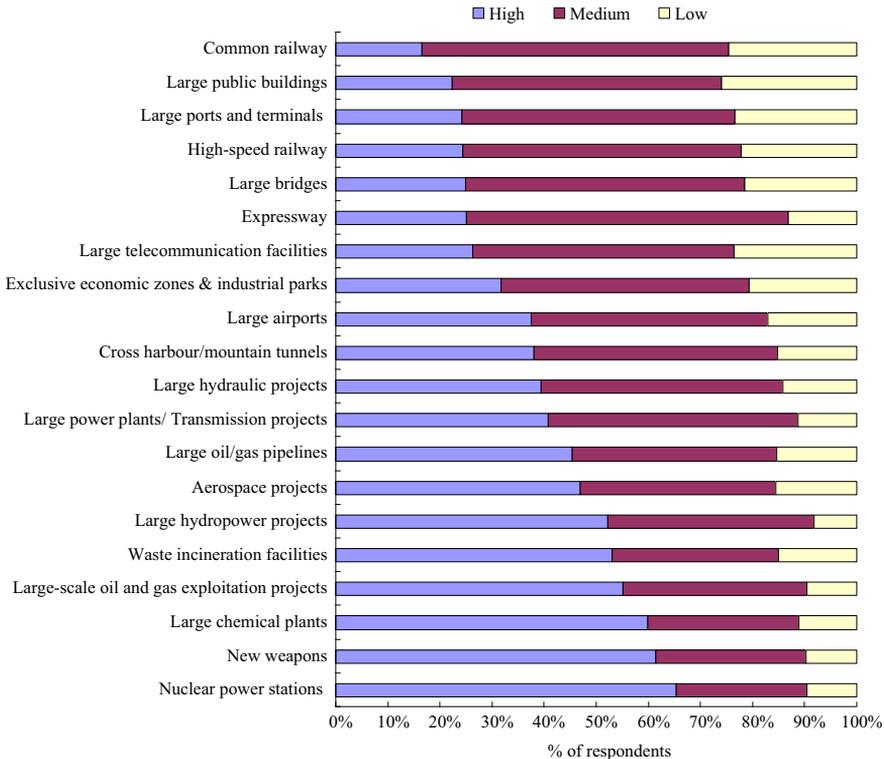


Fig. 5. Public perceived risks of the different infrastructures (N=828).

respectively). Respondents were also concerned about the environmental risks of energy/natural resources exploitation and transportation projects (oil, gas, hydro, electricity). In general, all mobility projects had relatively low levels of perceived risks, including high-speed railway. These findings were congruent with other studies, which found major public concerns on nuclear and chemical risks in China (He et al., 2011, 2013, 2014a, 2014b; Zhang et al., 2013) as well as in for instance the UK (Poortinga and Pidgeon, 2003; Pidgeon, et al., 2008).

Public acceptability of hazardous technologies depends, among other things, upon people's perceptions of both risks and benefits, and the balance between them. The in-depth interviews with local government officials, local EPBs and local transportation bureaus converged in the benefits of HSR far outweighing its (environmental and social) risks, which was in line with the formal position of the government. In general, the local residents underlined these views. More respondents thought benefits of high-speed rail far outweighed (35%) or slightly outweighed (26%) risks, compared to those who found its risks far outweighed (9%) or slightly outweighed (10%) any benefits. Respondents especially valued the social benefits (51%), followed by economic benefits (32%) and environmental benefits (17%). The perceived main economic benefits included logistics and transportation costs; regional economic development; facilitating the high-tech industry, construction and export business; boosting tourism and service industries; and real estate market development. Social benefits related to saving time, accelerating new urbanization, meeting needs of mobile people, changing lifestyles of residents, increasing employment, and raising the national pride of the public. The key environmental benefits were energy saving, air pollution reduction, and climate change mitigation. The results contrasted a survey in Susa Valley, Italy, where 66% of the interviewed residents saw very little to no (environmental and social) benefits that could justify the HSR project, and 56% of them feared that HSR construction would bring negative environmental impacts to the valley and harmful health consequences to its residents (Marincioni and Appiotti, 2009). Most Chinese

citizens thought the central government would benefit most from the HSR (19.5%), followed by construction and operation companies (19%), the local governments (18%), local residents (17%), future generations of politicians (10%), businessmen (9%), and foreign companies (7%).

## 7. Public trust in the information sources and related stakeholders

For information on environmental and social risks of HSR, the Chinese public relies especially on the MoR (23%), national media (22%), the central government (13%) and companies (13%). Only for a few respondents NGOs (2%), local media (3%), and research institutes & universities (4%) were relevant information providers on HSR environmental risks (Fig. 6). The central government was considered the most trustful source of information (29%), followed by the national media (16%), and research institutes & universities (11%). Few considered relatives and friends (2%), NGOs (2%) and local media (5%) a trustworthy information source (Fig. 6). This high trust in governance information is remarkable, and contrasts similar studies on HSR in other (western) countries; but is in accordance with our studies on nuclear power risks and on rural chemical risks in China, using a similar questionnaire (He et al., 2013, 2014b). Spearman correlation analysis showed that older people ( $p < 0.001$ ), respondents with less education ( $p < 0.05$ ), low income ( $p < 0.001$ ), and living in small towns and villages ( $p < 0.001$ ) relied more on central government and national media information on environmental risks of high-speed railways; but no significant differences existed regarding gender, career, party membership, and distance to the high-speed railway. Respondents with less education ( $p < 0.01$ ), a governmental profession ( $p < 0.05$ ), low income ( $p < 0.05$ ), being a party member ( $p < 0.05$ ), living in small towns and villages ( $p < 0.01$ ) and far away from the high-speed railway ( $p < 0.05$ ) had more trust in environmental risks information from the central government and national media; but no significant differences existed regarding gender and age.

Respondents were especially critical on the reliability of the disclosed information on the environmental impacts of HSR, while they judged the accessibility more favorably (Fig. 7). Most respondents thought that information access seriously affected (33%) and affected (59%) public opinion on the high-speed railway.

Trust is a desirable Chinese traditional cultural value. Compared with Western societies such as the United States, Chinese societies are low-trust societies. Furthermore, there was also a consistent lack of institutional trust in China (He et al., 2012a). In investigating trust we employed a three-point scale – high, average, and low (here we only used “high” category) – on four facets of trust: belief in the good intent and concern of partners, belief in their competence and capabilities, belief in their

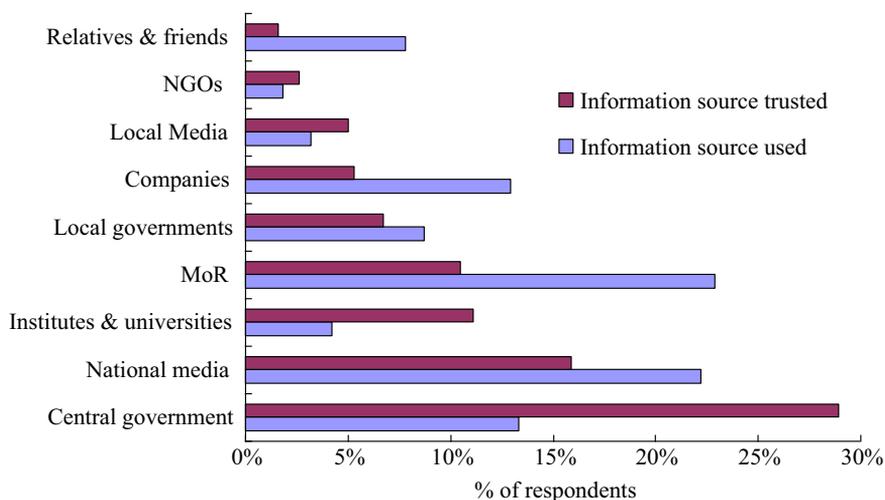


Fig. 6. Information sources used and trusted on environmental risk of high-speed railway.

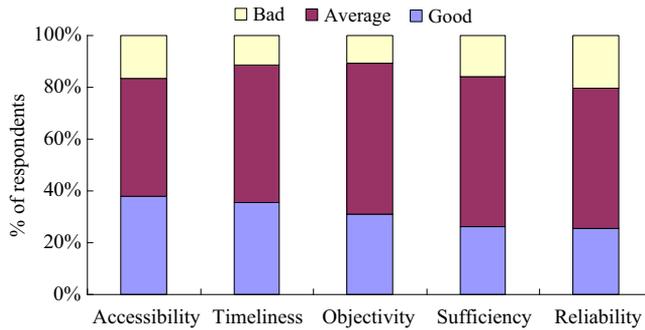


Fig. 7. Information quality assessment on environmental risk of high-speed railway by the public.

reliability, and belief in their perceived openness (Nahapiet and Ghoshal, 1998). For the Chinese public along the HSR the central government was considered as the most trustful organization regarding all four dimensions, followed by experts (with 56% of the respondents believing in their good intent and concern; 62% considered them competent and capable; 69% found their reliability high; and 62% perceived them open) (Fig. 8). Companies involved in railway construction and operation were perceived as the least trustful organizations, especially regarding their reliability (29% of respondents found them reliable) and perceived openness (28% considered the companies open). NGOs were trusted with respect to their good intent and concerns, but less so regarding their competences and capabilities (34%), and – surprisingly – perceived openness (31%). International organizations were less trusted for their intent and concerns, and their competences and capabilities. These results were largely consistent with previous research on trust with respect to nuclear power risk. Also the governmental authorities were much more trusted than other organizations involved (He et al., 2013).

## 8. Decision-making transparency and communication with public

The Beijing–Shanghai HSR was one of the key transport infrastructure projects in China's *11th Five-Year Plan (2006–2010) for National Economic and Social Development* and the *Medium and Long-Term Railway Network Plan 2005–2020*. All interviewed officials knew the former plan and heard of the latter. They were aware of the involvement of the State Council, the NDRC, and MoR in these plans, but did not know the details of the Beijing–Shanghai HSR decision-making process. Nearly 14% and 28% of the residents considered the decision-making on the Beijing–Shanghai HSR as “completely closed” and “closed”, respectively. Only 5% of the residents perceived it a fully transparent process. According to China's 2003 EIA Law, construction projects of this size must seek the opinions of relevant entities, experts and the general public by organizing demonstration meetings, hearings or by any other means. About one third of the residents knew of the Beijing–Shanghai HSR EIA and 18% of our respondents participated in it. Over half of the respondents (54%) had no idea how environmental risks of high-speed railways were managed, and 40% of them had limited knowledge on HSR risk management. Hence, only 6% of them had a clear idea of HSR environmental risk management.

Effective communication could avoid (environmental) conflicts between different stakeholders. About 9% and 6% of the respondents considered the communication between the local government and the public, and between railway companies and the public as sufficient, respectively (Table 2). Almost half of the respondents did not experience any communication from the key stakeholders regarding HSR construction. Most respondents indicated that, if given the opportunity, they would “certainly” (27%) and “possible” (58%) express their opinions to the local governments and related company sectors on the HSR construction and operation. The channels they preferred to use for expressing their opinions included Internet fora and micro-blogs (22%), petitions to governmental agencies (20%), conventional media such as television, radio and newspapers (20%), complaints with friends and family (13%), and violent protest (4%). Over 21% of the respondents considered any communication on their opinions with governmental agencies and companies “useless”.

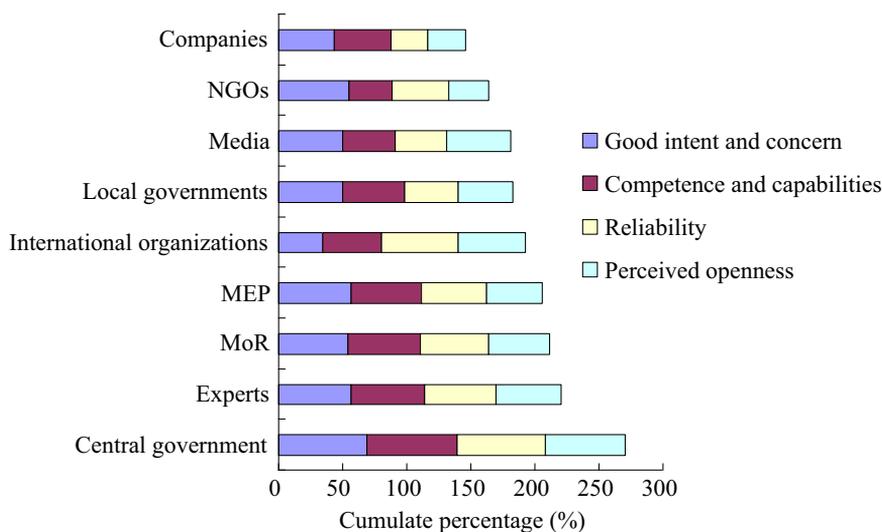


Fig. 8. Public trust in the different organizations on environmental risk management of high-speed railway (the horizontal axis provides the cumulative percentage of the four trust categories).

Table 2

Communication among the local government, companies and public on environmental risks of the Beijing-Shanghai high-speed railway ( $N=828$ ).

	Local government and public	Companies and public
No communication at all	42%	49%
Little communication	49%	45%
Sufficient communication	9%	6%

Table 3

Proposed suggestions on risk communication between government and public ( $N=696$ ).

Suggestions on risk communication	Percent (%)
Disclose information in various ways, especially via new media such as Internet, mobile phone, etc.	29
Implement effectively the specific information regulations such as <i>Governmental Information Disclosure Statute</i> and <i>Environmental Information Disclosure Decree</i>	23
Apply a two-way communication model	22
Increase the stakeholders' knowledge and awareness	11
Implement the official spokesman system	8
Build communication platforms	7

The main suggestions proposed by the respondents on improving environmental risk communication of the HSR are summarized in Table 3. Further information disclosure of governments and related agencies was mentioned most often (29%), followed by effective implementation of specific information regulations such as *Governmental Information Disclosure Statute* and *Environmental Information Disclosure Decree* (23%) and a stronger emphasis on two-way communication rather than one-way information provision. In addition, respondents showed major concerns about the speed of HSR construction, as half of the respondents (48%) believed that HSR development and construction should slow down and refocus on quality. In contrast, 19% favoured an accelerated development of HSR and 8% a moratorium on further development. Spearman correlations analyses indicated that respondents with a lower income ( $r=-0.082$ ,  $p<0.05$ ), living in large cities ( $r=0.091$ ,  $p<0.05$ ),

living far away from the HSR track ( $r=0.078$ ,  $p < 0.05$ ) and with lower risk perception on the HSR ( $r = -0.088$ ,  $p < 0.05$ ) were more supportive to a fast development of the HSR. Respondents' gender, age, level of education, profession, and party membership showed no significant differences in their support for the pace of the HSR development.

## 9. Conclusions

The rapid pace of the development and construction of high-speed railway projects are both a consequence of and a vehicle for China's accelerated development. High-speed railway has become the preferred medium distance (about 1000 km and less than 5 h traveling) traveling mode for most residents in this case, because of its speed, comfort and convenience. Hence, even along the HSR tracks more residents supported the construction of HSR than opposed it. Local government officials as well as residents along the HSR track judged that the benefits of HSR outweighed the (environmental and social) risks. Also, compared to nuclear and chemical risks, high-speed railway projects were perceived as low risk infrastructure projects. Environmental impacts of HSR were considered both as a benefit and as a negative environmental side-effect. If the Chinese have environmental reservations, these are rather directed at the impacts during operation and less so regarding the ecological impacts of construction. In that sense, the perceived environmental risk profile of HSR in China seemed to differ from environmental concerns in western countries. This explained the high acceptance of HSR in China.

But Chinese residents along HSR routes were quite critical on the information provisioning on and their participation in HSR decision-making. Decision-making on HSR was dominated by national governmental agencies (especially the State Council, NDRC, and the previous MoR). Local governments were promoters of HSR projects, but played hardly a role in decision-making and information dissemination. And the public had no corresponding voice and was hardly informed and involved in HSR developments, regardless the participation provisions of the EIA Law. Given this and the fact that high-level Chinese officials interpreted lack of trust in local government as one of the key problems of contemporary China (He et al., 2012a), it was still remarkable that the public placed high trust in the central government. Obviously, in a situation of restricted information on environmental and health impacts of HSR, Chinese citizens tended to rely on the central government as the most trustworthy source. Chinese citizens had similar low levels of trust in HSR construction and railway companies as the public in OECD countries.

An increasingly vocal civil society in contemporary China will have consequences for future environmental information disclosure, communication and participation of residents along newly planned and developed HSR lines. With more room for protest, discontent and media reporting, low levels of trust and credibility can have major consequences for smooth implementation of HSR lines. Experiences in Europe and North America showed that more transparency, communication, dialog and participation (also engaging regional and national organized NGOs who often had an interest in HSR) from the early start of HSR development helped in organizing the public debate and bringing (environmental) concerns into the planning and decision-making process, while at the same time building trust and preventing violent protests later. This is not only important for the future of infrastructure development but also for future environmental governance writ large in modern China.

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