

Analysis of Public Opinion Research on C-ICAP Automotive Privacy and Security

Jue Wang^a, Junbi Chang^b, Yueyou Wang^c

CATARC Automotive Test Center (Tianjin) Co., Ltd, Tianjin, China

^awangjue@catarc.ac.cn, ^bchangjunbi@catarc.ac.cn, ^cwangyueyou@catarc.ac.cn

Abstract

The Automotive Privacy and Security - Consumer Opinion Research Service Project aims to conduct extensive consumer research to gain a deeper understanding of the public's awareness, concerns, and expectations regarding privacy and security issues in smart cars. It provides data support and decision-making references for automotive manufacturers, policy makers, and industry regulatory agencies to promote the improvement of privacy protection mechanisms in smart cars and enhance consumer trust and satisfaction. This article sets up questionnaires and conducts multiple consumer surveys in the Beijing Tianjin Hebei region. Based on the research results, a large amount of analysis is conducted, and it is ultimately found that the core needs of consumers focus on multiple functions and privacy self-management. At the same time, the existing privacy protection measures are insufficient and difficult to meet consumer expectations.

Keywords

Consumer; Automotive Privacy and Security; Privacy Protection; Survey.

1. Introduction

With the rapid development of intelligent technology in automobiles, intelligent connected vehicles have gradually become the mainstream trend in the field of modern transportation. However, while enjoying the convenience and comfort brought by the intelligence of automobiles, the issue of automobile privacy and security is becoming increasingly prominent and has become a focus of public attention. In recent years, a series of automobile data breaches have occurred frequently, which not only infringe on users' privacy rights, but also pose potential threats to road traffic safety and even national security. Therefore, a deep understanding of the public's awareness and demand for automotive privacy and security is of great significance for promoting the healthy development of the automotive industry [1].

In this context, we conducted a public opinion study on automotive privacy and security. The purpose of this study is to collect public opinions, concerns, and expectations about automotive privacy and security through questionnaire surveys, interviews, and other methods, in order to provide decision-making references for the government, automotive companies, and relevant institutions, and jointly build a safer and more reliable automotive privacy protection system[2].

2. Research Samples and Results

Mainly relying on the Wenjuanxing platform to conduct research work. With the convenient questionnaire design and publishing function of Wenjuanxing, a questionnaire covering various aspects of privacy and security in smart cars has been carefully designed to ensure diversity and depth of questions, thus comprehensively understanding the public's views and

expectations on privacy and security in smart cars. Widely promote the questionnaire through multiple channels such as social media, email, and online forums to attract consumers of different professions, age groups, and income levels to participate. During the questionnaire distribution process, actively guide consumers to fill out the questionnaire carefully and improve its effectiveness. A total of 7128 questionnaires were collected in this online survey, and after a rigorous data screening process, 6928 valid questionnaires were finally determined. The survey results are shown in the following table:

Table 1. Research Results

1.What is your age?			9.What are the consequences of personal privacy information leakage that you are most concerned about in your daily life?		
option	subtotal	proportion	option	subtotal	proportion
18-24 years old	2078	29.99%	Identity theft, resulting in property damage or legal liability, such as impersonating acquaintances for fraud	2875	41.5%
25-34 years old	1316	19%	Personal privacy leakage triggers family conflicts or personal relationship tension	724	10.45%
35-44 years old	1247	18%	An increase in harassing phone calls, spam emails, and text messages	6896	99.54%
45-54 years old	1178	17.01%	Personal preferences and consumption habits are used for targeted advertising	4524	65.3%
55 years old and above	1108	16.01%	Personal reputation damage, affecting social image	1387	20.02%
2.What is your profession?			Personal location information leakage, affecting personal safety	2709	39.1%
On campus students	1584	22.86%	10. Which type of personal information do you think needs the most protection?		
Legal professionals	1756	25.35%	Basic personal information (such as name, address, contact information, personal account, etc.)	6188	89.32%
Practitioners related to intelligent networking	2677	38.64%	The interior camera captures images	2285	32.98%
other	911	13.15%	Personal biometric data (such as facial features, voiceprints, speech, etc.)	5449	78.65%
3.Does your family have a car?			Geographic location and route information	3190	46.05%
Yes, for traditional fuel vehicle users	3737	53.94%	Car app/mobile browsing history and chat history	2872	41.45%
Yes, for users of new energy vehicles	2154	31.09%	Records of consumption	3217	46.43%
deny	1037	14.97%	Camera outside the car/captured by someone else's phone camera	1327	19.15%
4.What is the price range of the cars owned by your family or your planned budget for purchasing a car?			Mobile phone/vehicle hard drive stores data files	3124	45.09%
Below 100000 yuan	2441	35.23%	Driving behavior data (braking frequency, speed, etc.)	2597	37.49%
100000 to 200000 yuan	1953	28.19%	11.Which of the following scenarios of personal information leakage in automobiles are you more concerned about?		
200000 to 300000 yuan	1310	18.91%	Automotive applications require users to authorize their names and phone numbers, resulting in frequent harassing phone calls	972	14.03%

300000 to 500000 yuan	737	10.64%	Cars share location information with third parties or other users, resulting in the leakage of travel information	4189	60.46%
500000 to 1 million yuan	358	5.17%	Unauthorized dissemination of photos taken by the in car camera, resulting in infringement of personal privacy	4563	65.86%
More than 1 million yuan	129	1.86%	Vulnerabilities in the automotive service provider platform have led to a large amount of user information being made public	5427	78.33%
5.If you were to purchase a car, which aspect would you value more?			Hackers remotely attack and manipulate cars, causing the car's functions to malfunction	892	2.88%
Traditional security	2950	42.58%	The car communication system (such as Bluetooth, car phone) has been hacked, and the conversation content has been eavesdropped	3025	43.66%
Degree of intelligent entertainment	4162	60.08%	Unauthorized third-party access to vehicle diagnostic data (such as driving habits, maintenance records)	1792	25.87%
Intelligent driving/assisted driving function	2038	29.42%	The in car information system leaks users' personal settings and preferences during the update process	5182	74.8%
User privacy protection	1075	15.52%	12.How do you think the privacy and security protection of automobiles is currently being done?		
Performance, such as speed	3110	44.89%	Very satisfied, very confident in the current privacy protection measures	124	1.79%
6.If you were to purchase a smart car, which features would you prefer to buy?			I am quite satisfied, but there is still room for improvement	3393	48.98%
option	subtotal	proportion	Not very satisfied, further strengthening is needed	2430	35.08%
voice control	1758	25.38%	Very dissatisfied, needs significant improvement	363	5.24%
facial recognition	1089	15.72%	I am not familiar with the specific measures and effects of car privacy protection, and cannot make an accurate evaluation	618	8.92%
Internet of Vehicles	4179	60.32%	Very satisfied, very confident in the current privacy protection measures	124	1.79%
In car video monitoring (such as child detention monitoring, driver fatigue monitoring)	4352	62.82%	13.Do you read the privacy policy when using a smart car?		
External environment monitoring (such as sentinel mode, Thousand Mile Eye)	4603	66.44%	Agree directly without reading	1080	15.59%
Intelligent driving	2248	32.45%	Browse briefly and then agree	2116	30.54%
In car intelligent payment	1781	25.71%	Agree on the key points of the reading section again	1653	23.86%
Remote control of the car through a mobile app (unlocking, locating, remotely turning on the air conditioning, etc.)	2131	30.76%	Agree after reading in general	1868	26.96%
7. Are you worried about your personal privacy information being leaked?			Read patiently and carefully before agreeing	211	3.05%
option	subtotal	proportion	14. Will you consciously manage the permissions of smart car applications in the settings?		
Very Worry	203	2.93%	Strong awareness and frequent management	810	11.69%
I'm a little worried	3515	50.74%	Moderate awareness, will manage frequent requests for permissions	2275	32.84%

Not too worried	3101	44.76%	Weak sense of consciousness, occasionally manage	2441	35.23%
I'm not worried at all	109	1.57%	I have a poor sense of consciousness and don't want to manage it. I don't think there's a big problem	1402	20.24%
8. Do you feel that your personal privacy may be monitored or leaked when using smart devices in your daily life? For example, after chatting with friends, the topic or product being discussed appears when opening a webpage or shopping app.			15. What channels do you usually use to learn about information related to car privacy protection?		
Yes, I often encounter situations where I feel my privacy is being violated	58	0.84%	Official website of automobile brand/APP	3602	51.99%
Sometimes it occurs, which makes me worry about privacy protection	2383	34.4%	Dealer/direct sales staff informed	2763	39.88%
Rarely encountered, but this possibility cannot be completely ruled out	1890	27.28%	Text/video/audio explanatory materials provided when purchasing a car	2502	36.11%
I haven't encountered it before, but I believe my privacy is secure	1187	17.13%	Social media and online forums	5424	78.29%
I'm not sure, I'm not very concerned about such situations	1410	20.35%	News reports and professional magazines	739	10.67%

3. Analysis of Research Results

3.1. Basic Information

Based on the research results of questions (1-4), summarize the basic situation as shown in Figure 1:

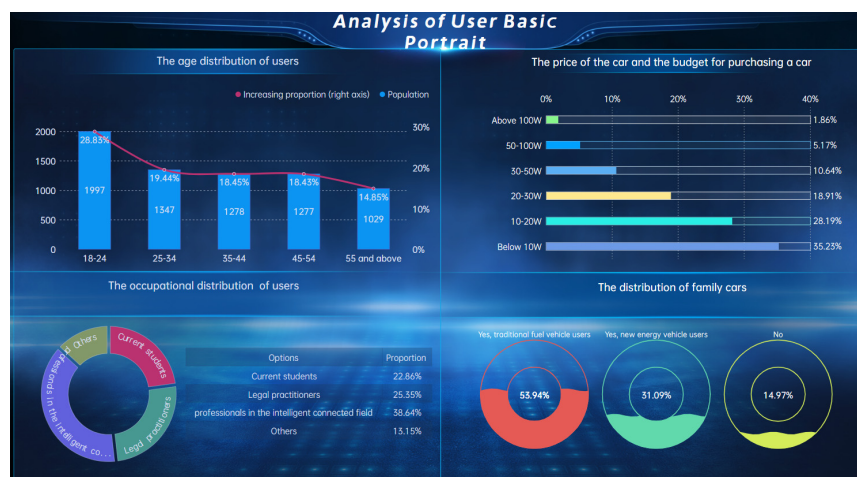


Fig 1. Basic Information and User Profile

From the perspective of age distribution, the population aged 18-24 has the highest proportion, reaching 28.83%, reflecting the active participation of young people in automotive privacy and security research. This may be due to the high acceptance of technology products in this age group, who are more concerned about emerging smart car privacy issues. The proportion of people aged 25-34, 35-44, and 45-54 is relatively balanced, with 19.44%, 18.45%, and 18.43% respectively, indicating that each middle-aged stage also values topics related to car privacy. The proportion of people aged 55 and above is 14.85%, which is relatively low, or due to the relatively less exposure to smart cars in this age group, the level of attention is slightly lower.

In terms of professional dimension, the proportion of practitioners related to intelligent networking is the highest, accounting for 38.64%. With their professional background, they have a deeper understanding of automotive privacy and security, and participating in research can provide a professional perspective. Legal professionals account for 25.35%, and due to their professional sensitivity, they pay more attention to privacy and security legal issues. School students account for 22.86%, reflecting the interest of young people in car privacy, which may be related to future car purchasing plans and attention to technology products [3].

In terms of household car ownership, traditional fuel vehicle users account for 53.94%, higher than the 31.09% of new energy vehicle users, indicating that traditional fuel vehicles still dominate the household ownership. However, the proportion of users of new energy vehicles cannot be ignored. With the development of new energy vehicles, their privacy and security issues will receive increasing attention.

In terms of car purchase budget, consumers with budgets below 100000 yuan account for the largest proportion, at 35.23%, while those with budgets between 100000 and 200000 yuan account for 28.19%. This reflects that most consumers' car purchase budgets are concentrated in the mid to low price range. Overall, different age groups have different focuses on various aspects of buying a car based on their own living conditions and needs. As shown in Figure 2, the purchase intention of smart cars.

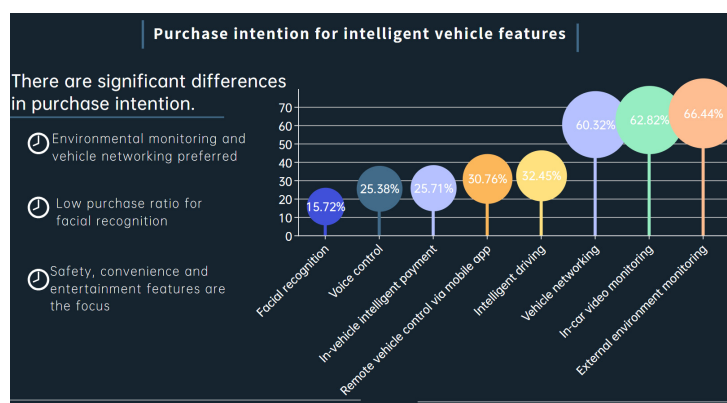


Fig 2. Purchase intention of smart cars

From the data, it can be seen that there are significant differences in consumers' willingness to purchase smart car features. The purchase proportion of external environment monitoring, in car video monitoring, and vehicle networking functions is relatively high, reaching 66.44%, 62.82%, and 60.32% respectively, indicating that users value the environmental monitoring and networking functions of vehicles, pay attention to driving safety and information exchange. However, the purchase rate of facial recognition function is only 15.72%, which is relatively low. Overall, users are more inclined to choose features that can enhance driving safety, convenience, and entertainment.

3.2. Consumer Attention to Privacy Protection

There are differences in the level of privacy concerns among different professions and age groups. From a professional perspective, professionals in the field of intelligent networking are "very worried" and "somewhat worried", accounting for 1.34% and 19.95% respectively. Due to their familiarity with potential risks in the industry, their level of concern is relatively high. The specific situation is shown in Figure 3:

The proportion of students in school and legal professionals is similar. Students have concerns about their daily dependence on the internet, while professionals have sensitivity based on their profession. The proportion of "other" professions is the lowest among all levels, as they

have less exposure to privacy leakage scenarios. In the first picture, the proportion of intelligent networking practitioners who are "very concerned" about privacy is 1.34%, much higher than the 0.59% of students in school; The proportion of "some concerns" reached 19.95%, while only 11.58% of students in school, which clearly shows that from the perspective of the overall sample, intelligent networking practitioners have a higher level of concern for privacy issues. After normalization, the proportion of intelligent networking practitioners who are "very worried" is 3.47%, while that of students is 2.59%, indicating a significant narrowing of the gap; In terms of "some concerns", the proportion of intelligent networking practitioners is 51.62%, while that of students is 50.63%. The two are very close, indicating that normalization eliminates the interference of differences in sample sizes among different professions, highlights the relative structure of privacy attitudes within each profession, and makes the relative differences in the degree of concern among different professions less significant than the original proportion, which can more accurately focus on the distribution of attitudes within the profession.

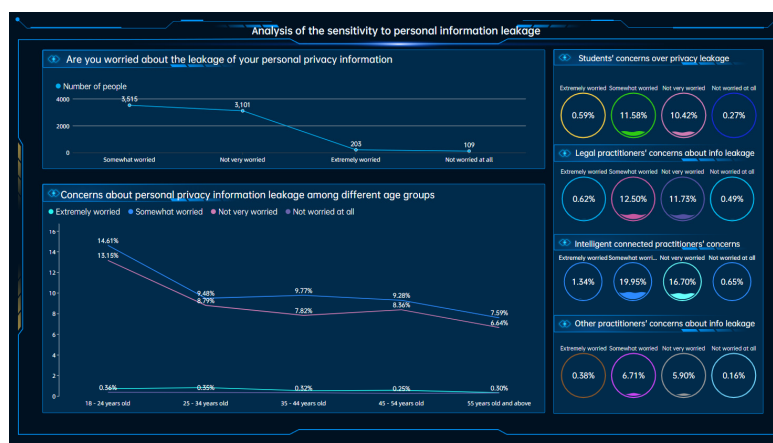


Fig 3. Sensitivity Analysis of Personal Information Leakage

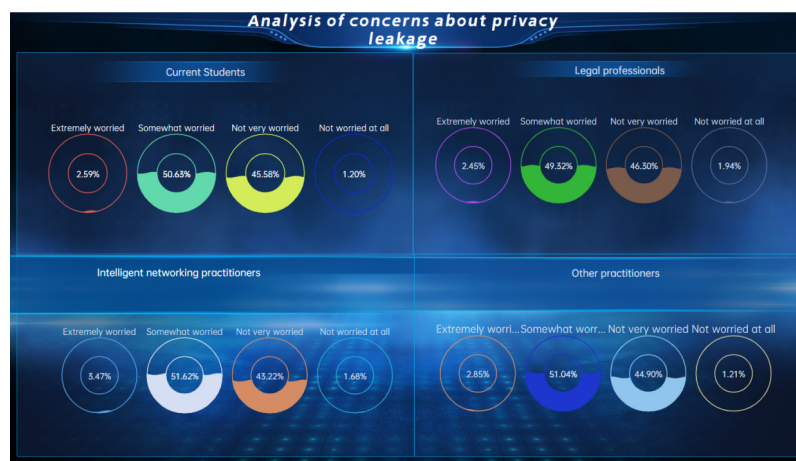


Fig 4. Sensitivity analysis of occupational impact

From an age group analysis, 0.71% and 14.61% of 18-24 year olds are "very worried" and "somewhat worried", respectively. They grew up in a highly developed online environment and rely on the internet to feel more at risk. From 25-34 years old to 55 years old and above, the proportion of "very worried" and "somewhat worried" generally decreases with age, as older people have lower dependence on the internet and less exposure to risk scenarios.

Overall, young people and professionals in information and technology related fields have high concerns about privacy, reflecting that those who have more exposure to new technologies place greater emphasis on privacy. However, older individuals and those in traditional professions have lower levels of attention, and there is a need to strengthen education on privacy protection awareness.

3.3. Ways to Protect Privacy

In the analysis of data related to privacy protection in intelligent vehicles, the "Intelligent Privacy Sound Shield" has a high proportion of 47.39%, highlighting its extremely high level of user attention. This means that emerging privacy technologies have successfully attracted a lot of attention, and users are full of expectations for advanced protection measures. The proportions of "controlling application access to personal data through permission management", "explaining privacy protection policies and user operations through animation", and "having clear prompts when collecting personal information" are 43.39%, 42.70%, and 41.21%, respectively, fully indicating that users attach great importance to actively controlling personal information and expect to have a clear understanding of the details of privacy protection policies and be able to perceive them intuitively during information collection. Up to 65.94% of users are willing to pay for advanced privacy protection features and sacrifice some convenience, demonstrating the high importance and strong willingness of users to pay for privacy protection. In terms of account information isolation, 67.19% of users acknowledge its necessity, but have concerns about convenience, as shown in Figure 5.

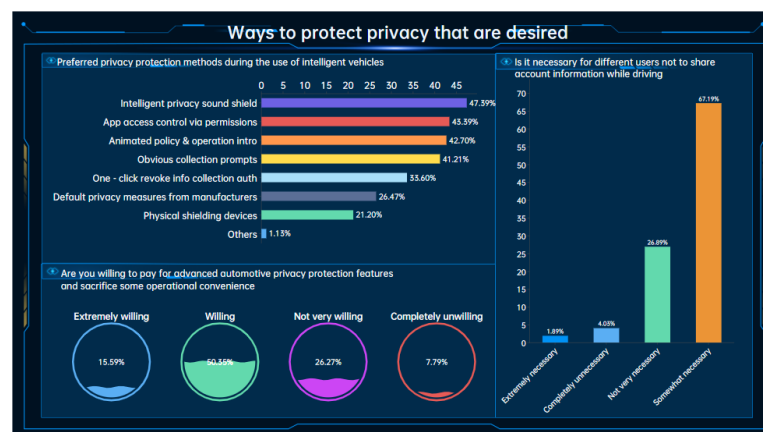


Fig 5. Ways to protect privacy

Further analysis found that among the user group who tend to actively control privacy protection methods (such as setting permission management), about 70% also agree that it is necessary not to share account information but are concerned about convenience; Among users willing to pay, over 75% tend to choose more proactive privacy protection methods. This deeply reflects the demand of users for active control and clear prompts of personal information, which is closely related to the need to protect privacy by not sharing account information. Moreover, users who are willing to pay have stronger demands for privacy protection methods and account information isolation. Based on this, car companies need to comprehensively optimize the design of privacy protection functions, carefully balance the relationship between convenience and privacy protection, reasonably formulate charging standards, and vigorously strengthen privacy risk publicity and education to effectively improve user experience and build a sound intelligent car privacy protection system.

4. Conclusion

Consumers have diversified demands for smart car functions, among which environmental monitoring and connected car functions are highly favored. The willingness to purchase external environmental monitoring online accounts for 66.44%, while offline accounts for 73.29%. In terms of privacy protection, the "Intelligent Privacy Sound Shield" has received high attention, with an online selection rate of 47.39% and an offline selection rate of 59.49%. At the same time, over 40% of consumers expect to achieve autonomous control over personal information by setting permission management control applications to access personal data. In terms of information acquisition, social media and online forums have become the main channels, accounting for 78.29% online and 85.20% offline. This not only reflects consumers' preference for convenient and diverse information acquisition methods, but also highlights the importance of digital channels in information dissemination. Consumers hope to obtain information on cutting-edge privacy protection technologies and evaluation results from authoritative institutions through these channels, in order to better understand the situation of automotive privacy protection.

References

- [1] The Practical Dilemma and Solution of Personal Information Rights Protection: Taking Several Judicial Cases as the Entry Point [J]. Xiao Denghui; ZHANG Wenjie. Information Theory & Practice, 2017 (02).
- [2] Path Reconstruction of Personal Information Protection in the Era of Big Data[J]. FAN Wei. Global Law Review, 2016(05).
- [3] The Private Law Attributes of Personal Information Rights in the Era of Big Data[J]. ZHANG Li'an; HAN Xuzhi. Legal Forum, 2016(03).
- [4] Current Situation and Development of Big Data Security[J]. WANG Qian; ZHU Hongfeng; LIU Tianhua. Computer & Network, 2013(16).