



Investigation report on public cognition and acceptance of gene editing

Sun Jianle
SJTU-BioX-Shanghai

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Science and technology are the primary productive forces and the concentrated expression and main symbol of advanced productive forces. In the third scientific and technological revolution since the 1960s, the rapid development of biotechnology has played an increasingly important role in scientific research, economic development and national strategic security, and has become a key area for technological competition in the 21st century. In 2018, the government of China began to develop the “National Biotechnology Development Strategy Outline”, and the development of biotechnology will enter the fast lane.

However, with the rapid development of biotechnology, the public and the frontiers of science and technology are out of touch, the public lacks understanding and understanding of cutting-edge knowledge; while the hidden dangers in the development of emerging technologies and the ethical sensitivities specific to biotechnology, It has added more public concern about it. Focusing on changing the current situation that science and humanity are increasingly separated, and the front line of scientific research is isolated from the general public, we have carried out research on the public perception and acceptance of gene editing technology with the popular genetic editing technology in recent years. In order to promote the public's understanding of cutting-edge science and technology, it also helps the front-line workers to listen to the public's views and opinions, understand public attitudes and ethical issues, and realize the connection between scientific research and the public. The blend of science and humanity.

I. Research Background

Gene editing is an emerging biotechnology. It can modify specific target gene of organisms by accurately identifying and locating specific fragments on the genome and cutting and adding them. In recent years, with the rapid development of molecular biology technology, gene editing technology has become more mature and perfect, especially the emergence of CRISPR gene editing technology, making gene editing technology a star in the field of molecular biology, in biological research and biotechnology. Open applications are playing an increasingly important role.

The CRISPR-Cas9 system was originally an immune mechanism in prokaryotes. CRISPR, known as Clustered Regularly Interspaced Short Palindromic Repeats, is a special sequence of bacterial and archaeal genomes with regular palindromic repeats; whereas Cas9 protein, A CRISPR-associated protein that specifically binds to a CRISPR sequence to form a CRISPR-Cas9 system. When foreign DNA enters the cell, the Cas9 protein exerts its endonuclease activity and is able to mediate defense against foreign DNA and incorporate new Spacers into the CRISPR region, thereby conferring “immune memory” to the cell. When the same foreign DNA invades again, the CRISPR sequence transcribes a specific crRNA, which binds to the Cas9 protein, recognizes the foreign DNA sequence and completes the cleavage.

Scientists have learned from the CRISPR-Cas9 system and developed an efficient genetic editing tool. Scientists design a gRNA sequence complementary to the target gene, and guide the Cas9 protein to bind to the target gene locus, so that the target gene can be cut. The cells also have the function of repairing the cleavage site according to the provided DNA template. If the designed gRNA is used to guide the CRISPR to cut specific regions of the DNA, and then provide a template to allow the DNA to rejoin according to the template, precise editing of the target gene can be achieved. However, Cas9 sometimes cleaves DNA sequences similar to the target DNA it is looking for, but these similar DNA sequences contain multiple different bases. These subtle differences may cause the gRNA to still bind to cause mis-cutting, which leads to the off-target phenomenon of CRISPR. This has become a major security risk affecting the application of CRISPR technology.

On the one hand, the public lacks understanding of the rapid development of modern biotechnology, and there are many prejudices and misunderstandings on emerging technologies including gene editing technology. On the other hand, new technologies such as gene editing itself have many technical problems at the beginning of development. In particular, the “off-target” problem of CRISPR gene editing has not been resolved, and it has become an important bottleneck restricting the development and application of new technologies, causing widespread public concern about biosafety issues. In addition, the practice of genetic editing technology to artificially transform biological genetic material has caused people to think about deep philosophical issues such as the relationship between man and nature and the rights and status of man in nature. The human being directly as the object of genetic editing, especially the He Jiankui “Gene Editing Baby” experiment of the Southern University of Science and Technology, which broke out in December last year, made the gene editing technology become the cusp of public opinion, and also involved more ethics behind biotechnology. , philosophical and social issues and arguments, making genetic editing

transcend the technology itself and involve human dignity and circumstances.

Focusing on changing the current situation that science and humanity are increasingly separated, and the front line of scientific research is isolated from the general public, we use genetic editing technology as a starting point to carry out research on the public cognition and acceptance of gene editing technology, hoping to set up research The first line of communication with the public is promoting the public's understanding of cutting-edge technology. It also helps front-line workers to listen to the public's views and opinions, understand public attitudes and ethical issues, and achieve academic and public connections, science and humanities.

II. Research Methods

As shown in Figure 1, this study uses gene editing technology as the main line, including two levels of empirical investigation and normative research. The empirical investigation is the main body and focus of the research, focusing on solving the problem of “what is being”, aiming to understand the general public's understanding and acceptance of gene editing technology; and normative research is complementary to the empirical investigation. Deepening, including the philosophical thinking of gene editing technology and analysis of relevant laws and regulations, based on understanding the basic attitude of the public, aiming to solve “what is ought to be” and “what to do (how to Do)” question.

The empirical investigation is the main body of research. We refer to a variety of domestic and foreign social survey research data, comprehensive use of questionnaires, interviews and observations for social surveys. We refer to a large number of successful questionnaire cases and completed the questionnaire design under the guidance of Associate Professor Zhou Kai of the school of Marxism, SJTU. In the questionnaire, we comprehensively adopted various forms of single-choice, multiple-choice, matrix, sorting, etc., comprehensively considering the genetic editing, technical security, ethics and economy of different objects such as microorganisms, animals and plants, food, human body and embryo. Investigating problems with different levels of factors such as cost, in order to obtain objective and comprehensive data. We fully considered the cultural level of the respondents and the psychological changes when filling out the questionnaire, optimized the topic description, and placed the personal information at the end of the questionnaire.

We use the combination of online and offline to distribute questionnaires. At the same time as the questionnaires are put on the major online platforms, street random questionnaires were distributed in Shanghai, Lianyungang City, Jiangsu Province, Kunming City, Yunnan Province, Dongfang City, Hainan Province, Yueyang City, Hunan Province, Xining City, Qinghai Province, and Mianyang City, Sichuan Province. We also selected the ordinary citizens who were willing to conduct in-depth interviews to learn more about their different attitudes towards genetic editing of different subjects and different purposes, and to randomly record video recordings on the street.

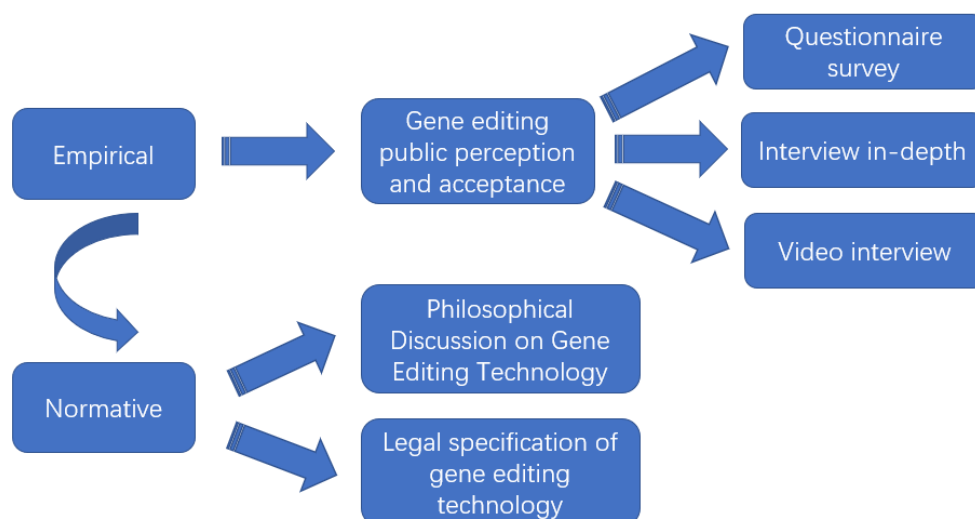


Fig.1 Research ideas

For the data and data obtained from the survey, we have adopted a combination of qualitative and quantitative analysis, as shown in Figure 2.

For the questionnaire data, we assigned the topic options, conducted the reliability and validity test of the questionnaire, and calculated the public's overall cognitive level and acceptance level of the gene editing semi-quantitatively, and accepted it using the statistical software SPSS. Descriptive statistics and correlation analysis of degree and cognitive level, examining the effects of different factors such as gender, age, occupation, education level, religious belief, income, etc. on cognitive level and acceptance level, and specifically examining the public's Different attitudes of genetic editing of different objects such as non-edible plants, non-edible animals, food, human cell medicine and human embryos, and analyzed the weight relationship between technical safety, ethics and economic costs in the development of gene editing technology in the eyes of the public. . The main analytical methods used are description statistics, correlation analysis, regression analysis, and nonparametric tests.

For the interview data, we used the method of qualitative analysis to carry out verbatim recording of text transcription, and carried out core concept coding and text content analysis. We learned more about the respondents' understanding of biotechnology and the different attitudes and causes of genetic editing of different objects such as microorganisms, non-edible animals and plants, human somatic cells and human embryos, and effectively supplemented the questionnaire data.

We also edited a video of random interviews on the street to provide more visual references to the research results.

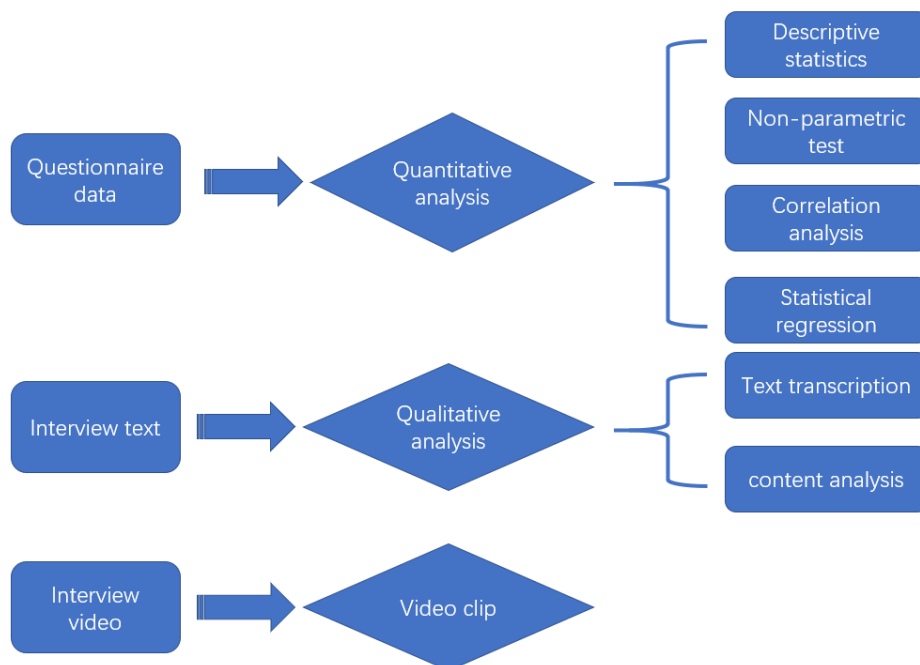


Fig. 2 Survey data analysis method

III. Questionnaire Data and Analysis

1. the overall situation of questionnaire data and the reliability and validity test of the questionnaire

A total of 1306 valid questionnaires were collected online and offline. The questionnaire data come

from different gender, age, occupation, income level, education level and religious belief in many provinces and cities in China, and have good universality and representativeness.

The questionnaire data are first assigned and encoded. The specific way of assignment is shown in the appendix.

Firstly, the questions about cognition and acceptance are screened out, and the reliability test is carried out by using the “reliability analysis” function of SPSS, and the α value is calculated. The results are shown in Table 1 and Table 2.

Table 1 Reliability Test of Issues Related to Cognition

Reliability Statistics	
Cronbach's Alpha	N of Items
.841	9

Table 2 Reliability Test of Issues Related to Acceptance

Reliability Statistics	
Cronbach's Alpha	N of Items
.837	15

From the data in Table 1 and Table 2, it can be seen that the test α values of cognitive level and acceptance degree are 0.841 and 0.837, respectively, both of which are above 0.8, which indicates that the overall reliability of the questionnaire is not bad.

Then the “factor” option of SPSS is used to test the structural validity of each question data of the questionnaire, and the KMO value and significance level are calculated. The results are shown in Table 3.

Table 3 Validity Test of Questionnaire Structure

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.895
Bartlett's Test of Sphericity	Approx. Chi-Square	14665.301
	df	528
	Sig.	.000

According to the data in Table 3, the KMO value is 0.895, and the significance level is much less than 0.01, which indicates that there is a significant correlation among the variables of each question of the questionnaire. And the questionnaire is suitable for factor analysis, which shows that the validity of the questionnaire is not bad.

2. the Total Cognitive Level and Total Acceptance of the Sample

(1) Description and Statistics of Total Cognitive level and Total Acceptance of Samples

The total cognitive level score C (cognition) and the total acceptance level score A (accept) of the sample were calculated according to each question score as follows. “Total” means the general knowledge and acceptance of the genetic editing of organisms, animals, plants, humans, etc.

Note a is the total score of question 1 of part one, b is the total score of question 2 of part one, and c is the total score of question 4 of part one, then

$$C = \frac{a}{10} \times 50 + \frac{b}{4} \times 20 + \frac{c}{3} \times 30$$

Note: d is the total score of the first question of the second part, and e is the total score of the second part (with the exception of the second expression, the negative expression is transformed according to the “6-score” method before summation). Then

$$A = \frac{d}{30} \times 50 + \frac{e}{45} \times 50$$

In this way, the cognitive level and acceptance are unified into percentage system, which is convenient for follow-up analysis.

It should be noted that because most of the questions are ordered variables that reflect the degree of cognition and acceptance, the operation of calculating the total score is only for the convenience of data processing, and the total score is still a ordered variable in essence.

The total cognitive level and total acceptance degree in the sample were described and counted by SPSS, and the histogram was drawn. The results are shown in Table 4, Fig. 3 and Fig. 4.

Table 4 Description Statistics of Total Cognitive Level and Total Acceptance of Samples

		Statistics	
		total_recogniz e	total_accept
N	Valid	1306	1306
	Missing	0	0
Mean		53.8936	64.9561
Std. Error of Mean		.65331	.34943
Median		50.0000	64.7222
Mode		50.00	69.72
Std. Deviation		23.60963	12.62800
Variance		557.415	159.466
Skewness		.109	-.180
Std. Error of Skewness		.068	.068
Kurtosis		-.635	.056
Std. Error of Kurtosis		.135	.135
Range		100.00	74.31
Minimum		.00	25.69
Maximum		100.00	100.00
Sum		70385.00	84832.64

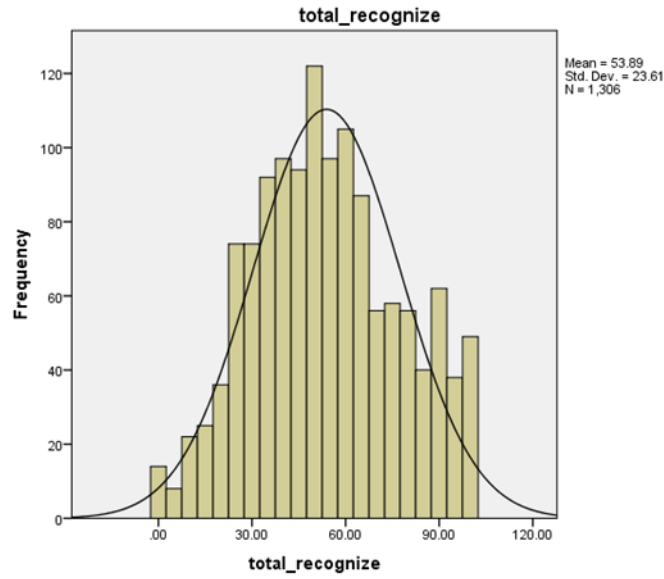


Fig. 3 Histogram of Total Cognitive Level Distribution in Samples

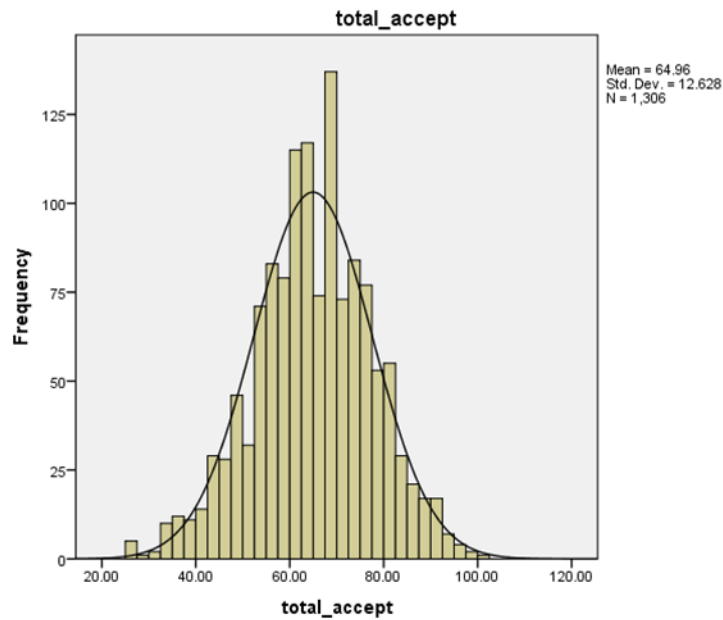


Fig. 4 Histogram of Total Acceptance Distribution of Samples

The cognitive level and acceptance degree of the samples were tested by P-P and Q-Q normal tests, and the results were shown in Fig. 5 and Fig. 6.

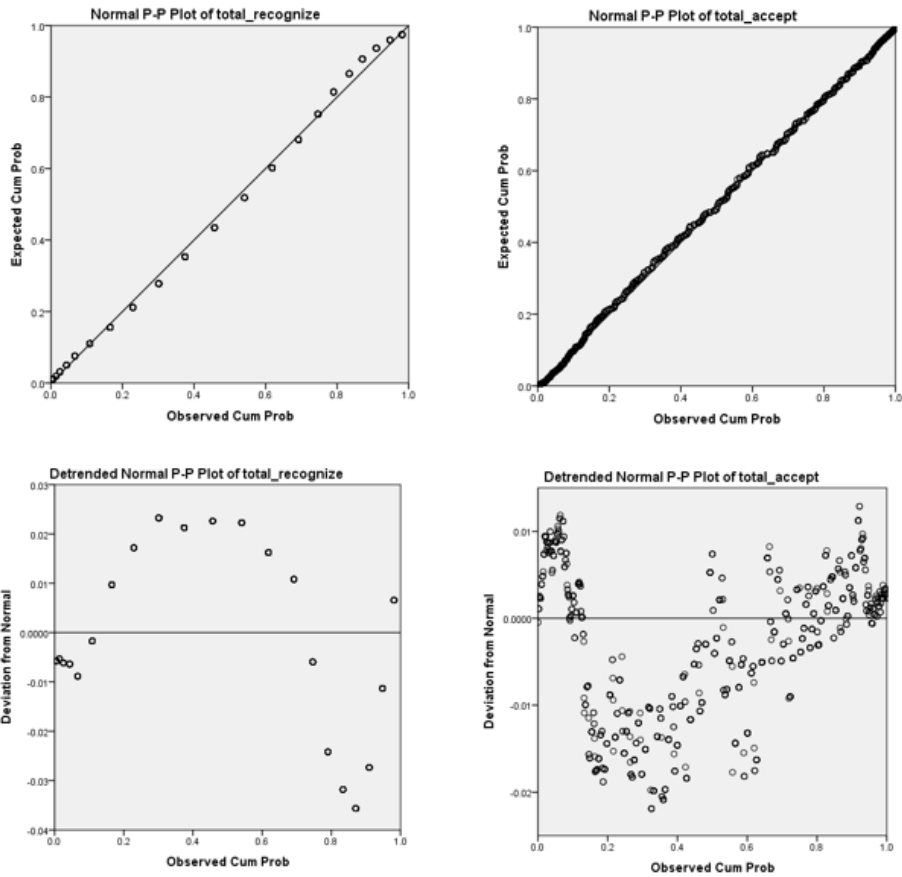


Fig.5 P-P Test of Total Cognitive Level and Total Acceptance

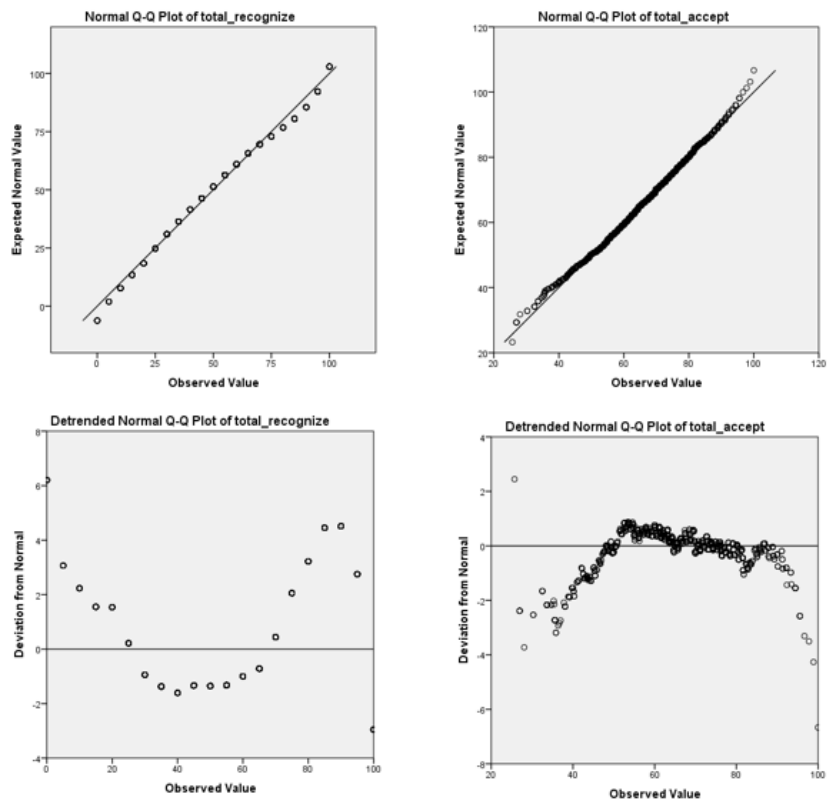


Fig.6 Q-Q Test of Total Cognitive Level and Total Acceptance

It can be seen from Fig. 3-Fig. 6 that the total acceptance degree in the sample is in line with the normal distribution, and both P-P and Q-Q diagrams are very close to the straight line, which reflects the fact that the public acceptance of gene editing tends to be mild on the whole. And very few people support all kinds of gene editing and oppose all kinds of gene editing in an extreme way, which is also in line with our expected judgment.

But the total cognitive level of the sample was far from the normal distribution, and the number of high

segmentation was more than that of low segmentation. There are two reasons for this: one is that the questionnaire itself has a selection preference, and those interested in the topic of gene editing who have some knowledge are more willing to fill out the questionnaire, so the proportion of high cognitive level in the sample is larger; the other is that when designing the questionnaire, taking into account the friendliness of the public when filling out the questionnaire, the question setting of the test cognitive level is more basic, which also results in the overall high score.

Specifically, in the cognitive self-assessment, the proportion of “do not understand” in the cognitive self-assessment of CRISPR system, which involves the specific mechanism of gene editing, is as high as 73%, which is much larger than the general nouns such as transgenic, gene-targeted therapy and so on. In the objective multiple choice question, “successful transfer of a new gene into mouse liver cells, will the gene appear in its offspring?” The error rate of selection is more than 50%, which indicates that the public's understanding of gene editing focuses on the basic concepts and the general understanding of hot news, but the understanding of the specific mechanism is very limited. Because the questionnaire takes into account this factor, the problem setting is relatively simple, and the calculated cognitive score is also relatively high.

The public's cognitive source of information related to gene editing is shown in figure 7 (because of multiple choice, the sum of the percentages of the options is not 1). It can be seen that the Internet has become the main channel for Chinese residents to understand the frontier science and technology such as gene editing, while books, newspapers, television, radio and other traditional media still play an important role. Bringing cutting-edge scientific and technological knowledge into classroom education also plays an important role in improving the overall cognitive level of the public. Due to the emergence of hot news such as He Jiankui incident, people have also begun to dabble in cutting-edge scientific and technological fields such as gene editing in their daily conversations.

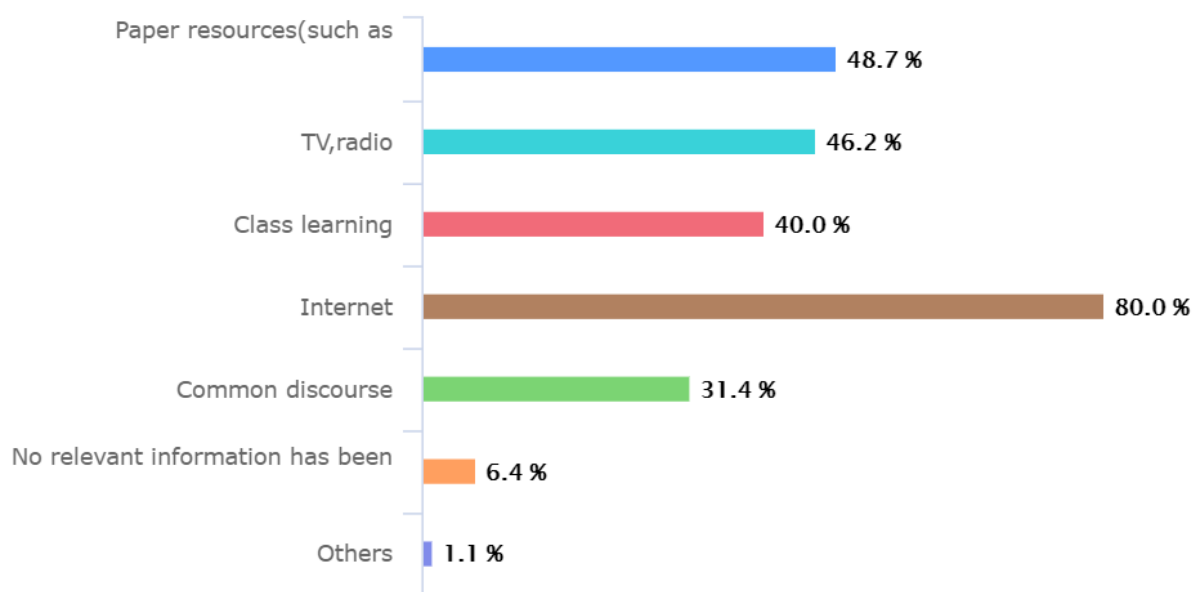


Fig. 7 Channels for the Public to Learn about Information such as Gene Editing

(2) the Relationship between Cognitive Level and Acceptance

The correlation between cognitive level and acceptance was tested by bivariate correlation analysis of SPSS. Because the cognitive score and acceptance score mentioned above are essentially ordered variables, the Kendall- τ correlation coefficient and Spearman correlation coefficient are used to analyze the cognitive score and acceptance score. The results are shown in Table 5.

Table 5 Analysis of the Correlation between Cognitive Level and Acceptance

Correlations

			total_recogniz e	total_accept
Kendall's tau_b	total_recognize	Correlation Coefficient	1.000	.261**
		Sig. (2-tailed)	.	.000
		N	1306	1306
	total_accept	Correlation Coefficient	.261**	1.000
		Sig. (2-tailed)	.000	.
		N	1306	1306
Spearman's rho	total_recognize	Correlation Coefficient	1.000	.372**
		Sig. (2-tailed)	.	.000
		N	1306	1306
	total_accept	Correlation Coefficient	.372**	1.000
		Sig. (2-tailed)	.000	.
		N	1306	1306

** . Correlation is significant at the 0.01 level (2-tailed).

According to Table 5, the correlation coefficients between cognitive level and acceptance are 0.261 and 0.372, respectively, which indicates that there is a positive correlation between cognitive level and acceptance, but the correlation is not strong. That is, people who know more about gene editing are more likely to accept the application of the technology, but there are limits to acceptance.

Linear and logistic regression analysis was carried out with cognitive level as independent variable and acceptance degree as dependent variable. The results were shown in tables 6 and 8. It should be noted that because these two scores are ordered variables, the actual significance in regression analysis is mainly the general trend of the curve rather than the specific parameter value.

Table 6 Regression Analysis of Acceptance and Cognitive Level

Model Summary and Parameter Estimates

Dependent Variable: total_accept

Equation	R Square	Model Summary				Parameter Estimates	
		F	df1	df2	Sig.	Constant	b1
Linear	.147	224.441	1	1304	.000	53.910	.205
Logistic	.135	203.608	1	1304	.000	.019	.997

The independent variable is total_recognize.

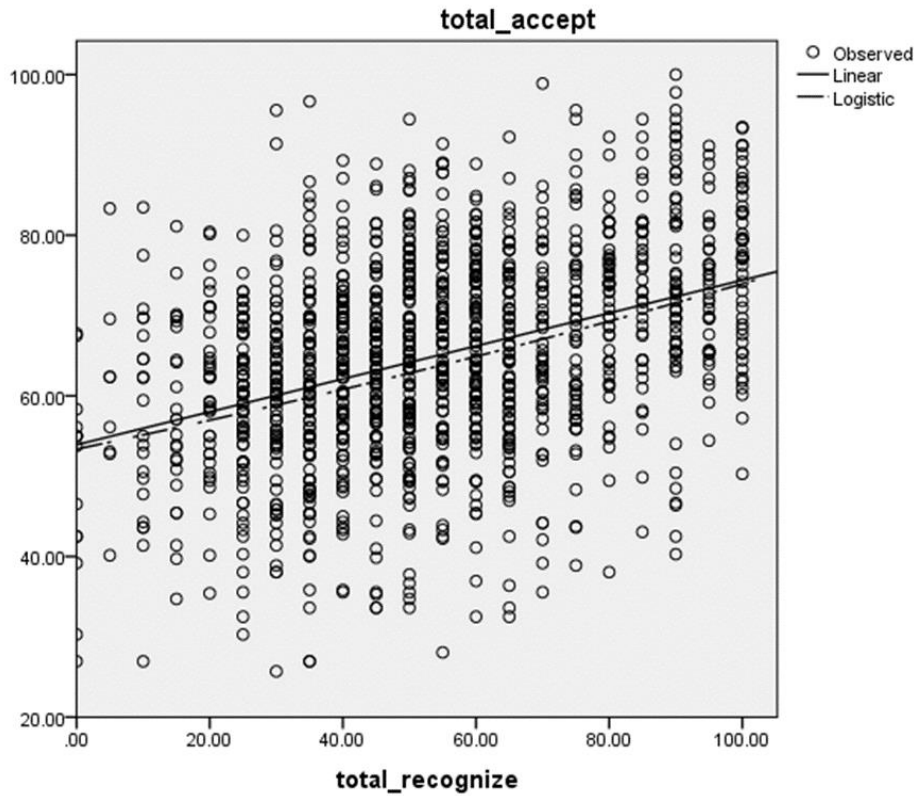


Fig. 8 Regression Analysis of Acceptance and Cognitive Level

The results of regression analysis confirmed the results of correlation analysis. That is, there is a positive correlation between acceptance and cognitive level.

3. Factors Affecting Cognitive Level and Acceptance

(1) The Impact of Gender

Excluding the data selected for “indisclosure” in the gender item, the gender distribution of cognitive level and acceptance was described, as shown in figure 9.

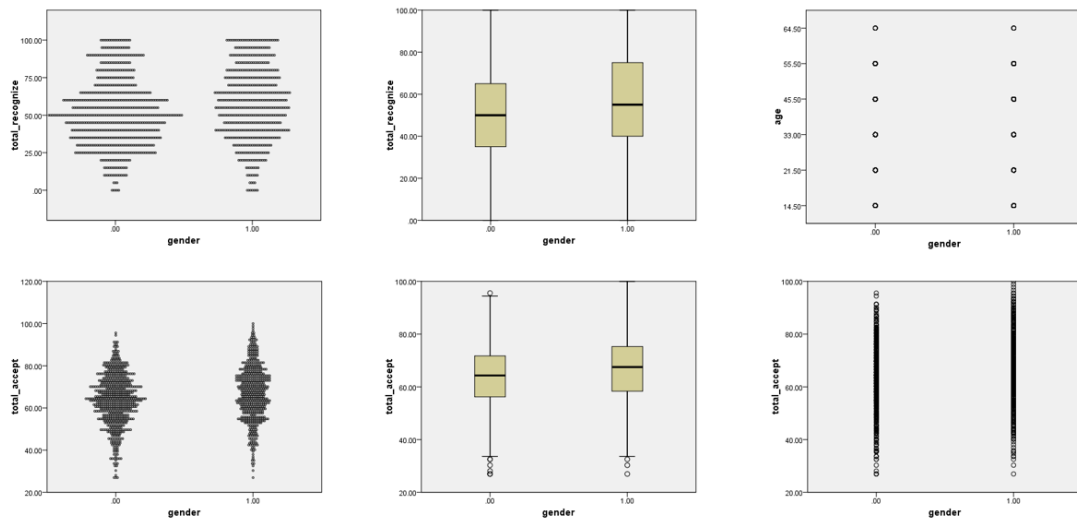


Fig. 9 Effects of Gender on Cognitive Level and Acceptance (0 for women and 1 for men)

It can be seen intuitively from figure 9 that, in general, men have a higher level of cognition and acceptance of gene editing techniques than women.

Mann-Whitney U test was carried out by SPSS, and the confidence interval was 95%. The results were shown in Table 7 and Fig. 10.

Table 7 Mann-Whitney U test for gender grouping

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of gender.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of gender.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

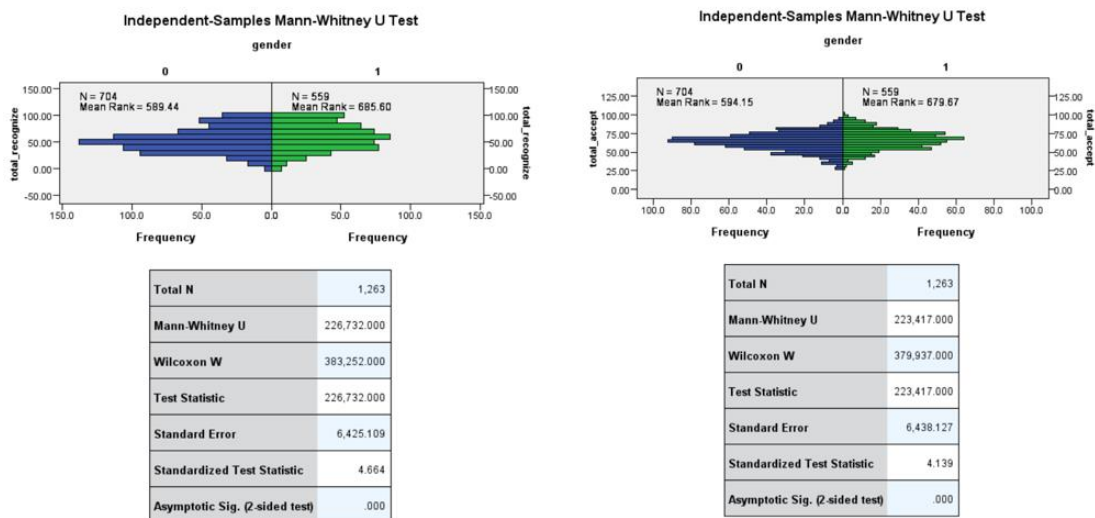


Fig. 10 Mann-Whitney U test for gender grouping

The results of Mann-Whitney U test showed that sex had a significant effect on cognitive level and acceptance in 95% confidence interval. Compared with figure 8, men scored higher than women in terms of cognition and acceptance of gene editing.

(2) The Impact of Age

The Kruskal-Wallis test of age groups was carried out by SPSS, and the confidence interval was 95%. The results were shown in Table 8-10.

Table 8 Cognitive level-Age Kruskal-Wallis Test

Total N	1,306
Test Statistic	398.253
Degrees of Freedom	5
Asymptotic Sig. (2-sided test)	.000

Table 9 Acceptance-Age Kruskal-Wallis Test

Total N	1,306
Test Statistic	184.109
Degrees of Freedom	5
Asymptotic Sig. (2-sided test)	.000

Table 10 conclusion of Kruskal-Wallis test for age groups

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of age.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of age.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Kruskal-Wallis test showed that age has a significant effect on cognitive level and acceptance in 95% confidence interval. Make a distribution map as shown in figure 11.

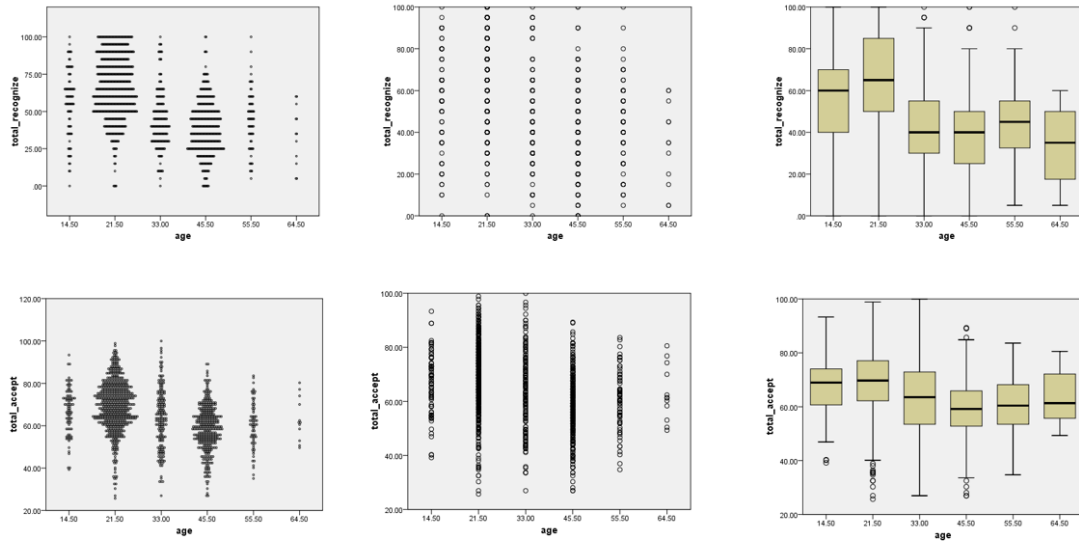


Fig. 11 the Effect of Age on Cognition and Acceptance (age is replaced by group median, and the method of calculating the median value of both groups is end point \pm half of adjacent group spacing).

It can be seen from figure 11 that the cognitive level of the new technology of gene editing decreases with the increase of age as a whole. According to the results of the grouping, the young people aged 18-25 have the highest degree of cognition and acceptance, which may be due to the fact that they are in a golden age of easy understanding and acceptance of new things, and their educational level is also relatively high. Compared with the surrounding group, 51-60 years old has a small peak of cognitive level, which may be due to the fact that most of the children have reached adulthood, their careers tend to be stable or retire, their lives are less stressed, their energy is more abundant, and they pay more attention to hot news events.

This analysis can also be supported by a broken-line diagram of the average number of hot news events (Question 2, Part I of the questionnaire) and age groups, as shown in Figure 12.

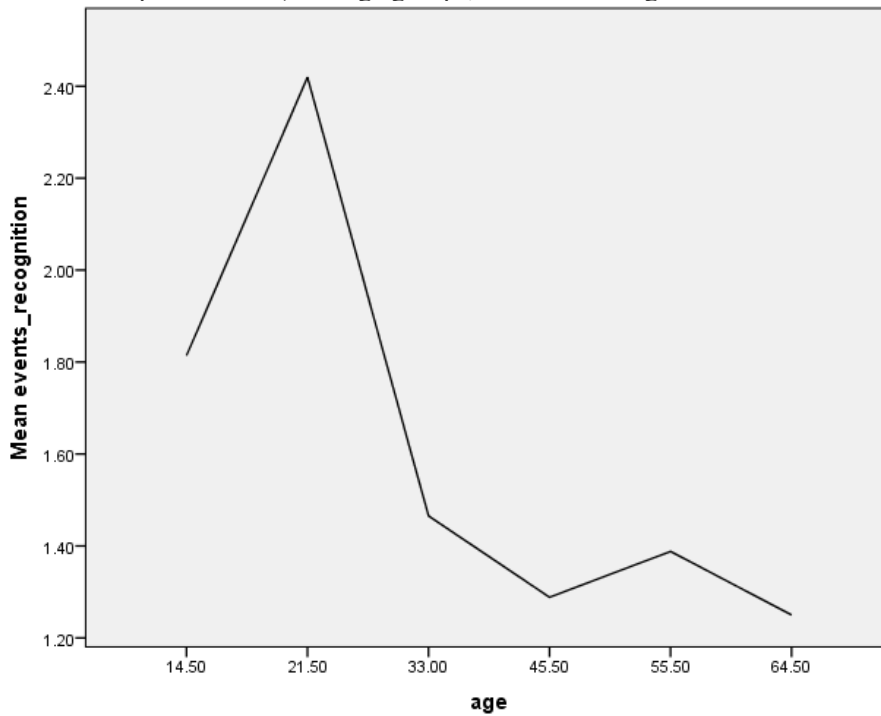


Figure 12 an Understanding of Gene Editing Related Hotspot Events at Different Ages.

SPSS was used to analyze the cognitive level, acceptance and age (replaced by the median value of each group, and the median value of the two groups was calculated as end point \pm half of adjacent group spacing). The results were shown in Table 11, 12 and Fig. 13.

Table 11 Cognitive level-age Regression Analysis

Model Summary and Parameter Estimates

Dependent Variable: total_recognize

Equation	R Square	Model Summary				Parameter Estimates	
		F	df1	df2	Sig.	Constant	b1
Linear	.223	373.197	1	1304	.000	81.557	-.881
Logistic ^a	.	.	.	.	.	.	.

The independent variable is age.

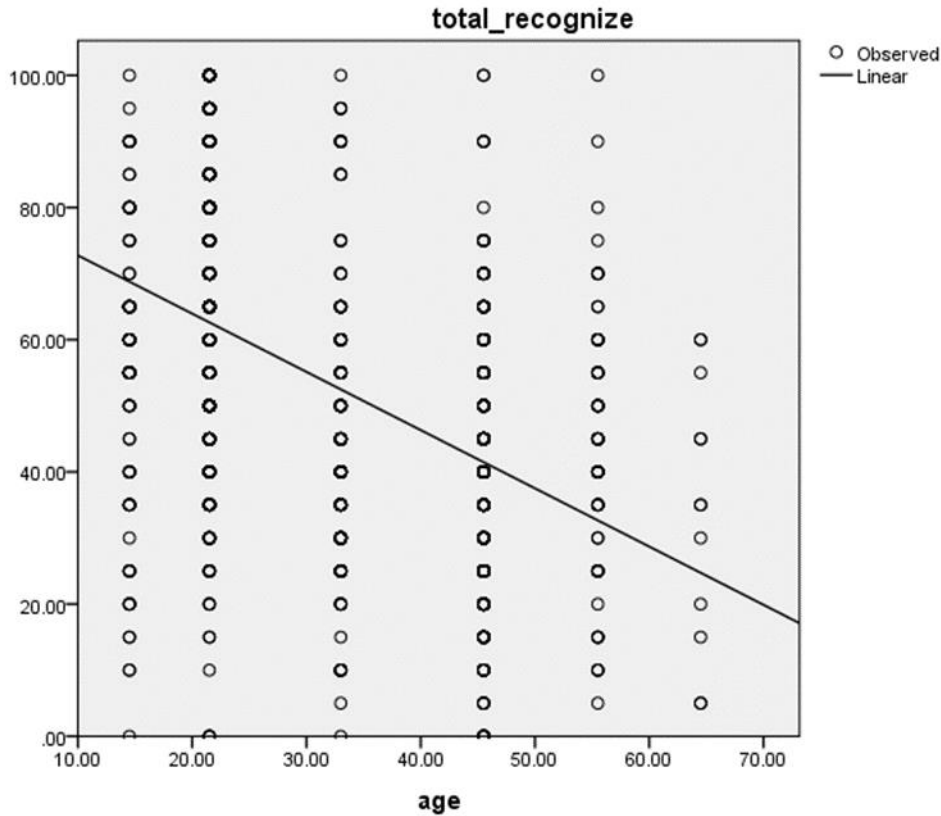


Fig. 13 Cognitive level-age Regression Analysis (age replaced by group median)

Table 12 Acceptance and Age Regression Analysis

Model Summary and Parameter Estimates

Dependent Variable: total_accept

Equation	R Square	Model Summary				Parameter Estimates	
		F	df1	df2	Sig.	Constant	b1
Linear	.108	158.422	1	1304	.000	75.280	-.329
Logistic ^a	.099	143.827	1	1304	.000	.013	1.005

The independent variable is age.

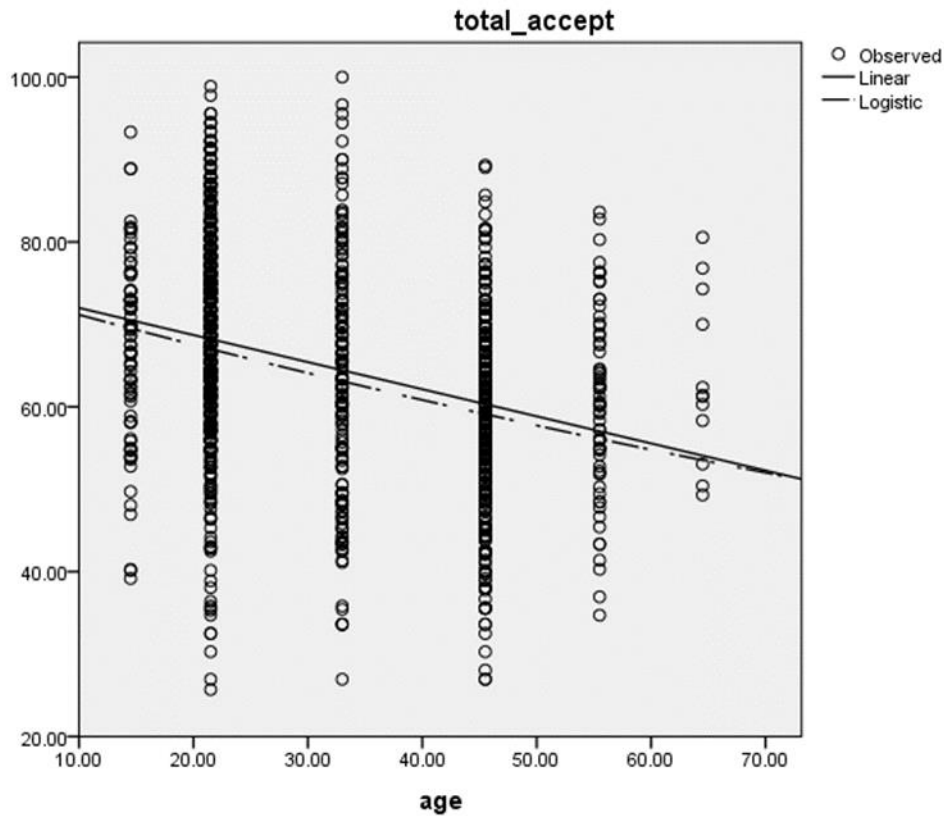


Fig. 14 acceptance-age regression analysis (age replaced by group median)

According to the results of regression analysis, although there is a small peak in the 51-60 age group, overall, the older the age, the lower the cognition and acceptance of gene editing, and in contrast, the cognitive level is more affected by age than acceptance. On the one hand, the older the desire to know and accept new things will decline; on the other hand, in China, because of historical reasons, the chances and proportion of the younger generation to receive higher education are objectively higher than the older generation, which is also a reason for this phenomenon.

(3) The Impact of Residence

According to the three categories of rural, small and medium-sized cities and large cities, Kruskal-Wallis test was carried out, and the test results are shown in Table 13-15.

Table 13 Cognitive level-residence Kruskal-Wallis test

Total N	1,306
Test Statistic	113.231
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.000

Table 14 acceptance-residence Kruskal-Wallis test

Total N	1,306
Test Statistic	47.988
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.000

Table 15 Conclusion of Kruskal-Wallis test in residential group.

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of habitat.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of habitat.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

The results of Kruskal-Wallis test showed that the living place had a significant effect on cognitive level and acceptance in 95% confidence interval. Make a distribution map as shown in figure15.

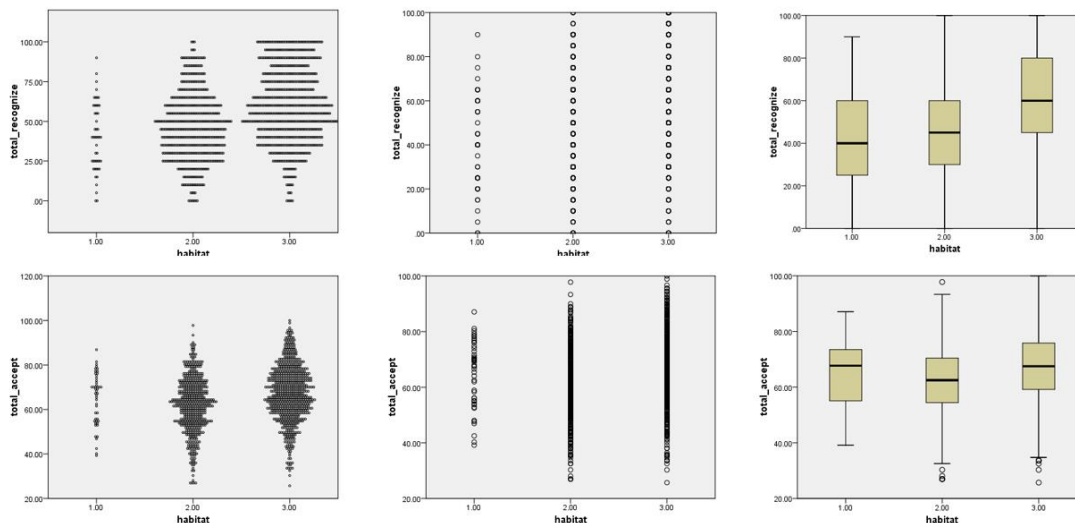


Figure 15 impact of place of residence on cognitive level and acceptance (1 for rural areas, 2 for small and medium-sized cities and 3 for large cities)

From figure 15, it can be seen that from rural areas to small and medium-sized cities to large cities, the public's awareness of gene editing has gradually improved, especially in large cities, which are significantly higher than those in rural and small and medium-sized cities. This is also in line with our expectations. Large cities are relatively developed in science and education, and there are many channels for the public to access information, and they have a high understanding of the new technology of gene editing. But acceptance has not changed according to the same trend. On the contrary, public acceptance in rural areas is not low.

From the observation of field investigation, it is found that because of the low understanding of gene editing technology in rural areas, most of the rural areas do not understand the advantages and risks of gene

editing put forward by both sides of the debate, and most of them have a indifferent attitude. In addition, when the masses filled out the questionnaire, they said, “what our attitude is, anyway, it is up to the rich officials to decide what they want, and we have to accept it, and we don't care.” Their indifferent and casual attitude leads to the fact that although the level of public awareness in rural areas is very low, the degree of acceptance is not low.

The same conclusion can be seen from the error bar chart shown in figure 16 and 17.

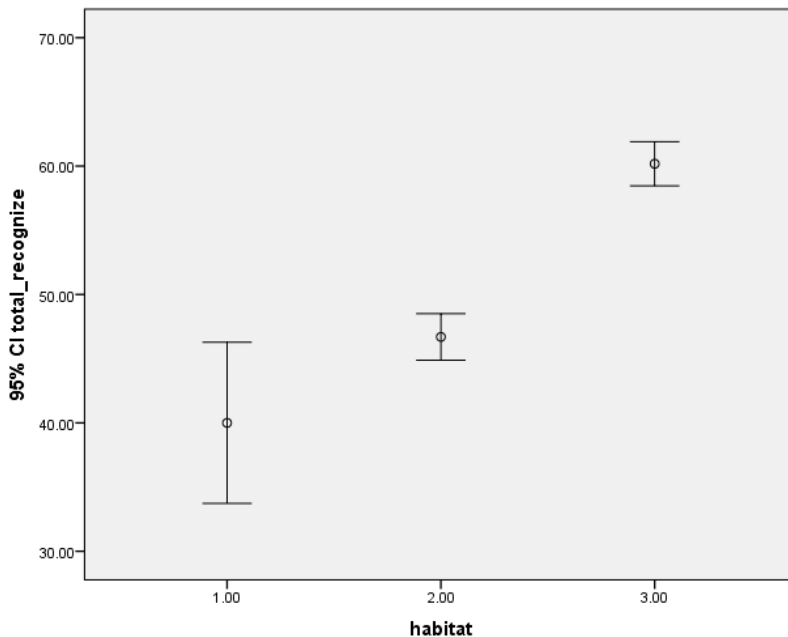


Figure 16 Cognitive level-residence error bar map (1 for rural areas, 2 for small and medium-sized cities, 3 for large cities)

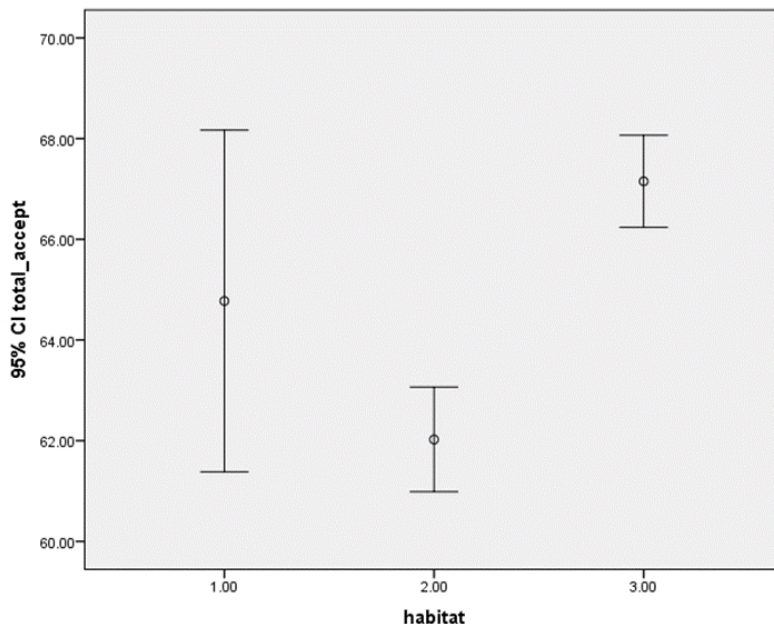


Figure 17 acceptance-residence error bar chart (1 for rural areas, 2 for small and medium-sized cities, 3 for large cities)

Compared with figures 16 and 17, we can see that in the cognitive level, the scores of the rural, small and medium-sized cities and the large urban public are relatively concentrated; but in the degree of acceptance, the fluctuation range of the data obtained by the residence in the countryside is very large. This is affected by the relatively small number of rural data samples. But it also reflects that people in rural areas know little about gene editing and have a casual attitude towards it. So the data fluctuate greatly up and down, the mean is relatively not low.

(4) The Impact of Religious

Because the samples collected from each religion are relatively small, the data are analyzed according to the existence or absence of religious beliefs. Using SPSS for Mann-Whitney U test, the confidence interval is 95%. The results are shown in Table 16.

Table 16 Presence or Absence of Religious Belief Mann-Whitney U Test

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of if_religion.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of if_religion.	Independent-Samples Mann-Whitney U Test	.043	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

From the results of Mann-Whitney U test, it can be seen that the presence or absence of religious belief has a significant impact on cognitive level in 95% confidence interval. Combined with Fig. 18, it can be seen that the cognitive degree of the public without religious belief is higher than that of the general public without religious belief.

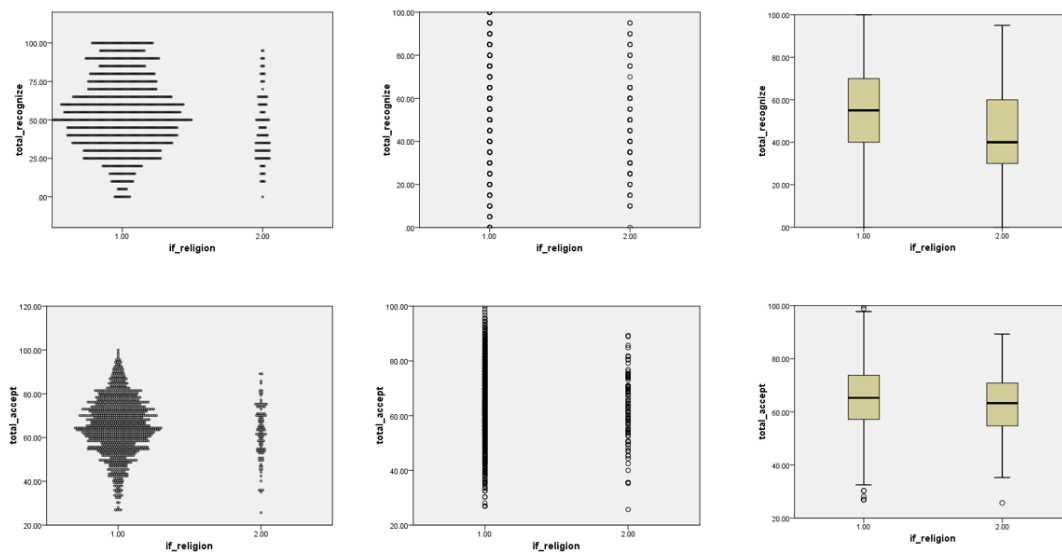


Fig. 18 Influence of Religious Belief on Cognitive Level and Acceptance (1-none; 2-yes)

The reason for this is likely to be that in China, people with religious beliefs as a whole are less educated, as shown in figure 19, 20, so they have a lower understanding of genetic editing.

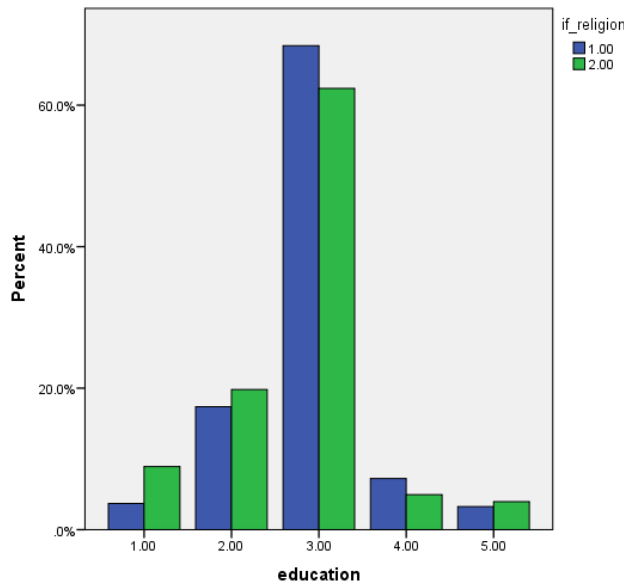


Fig.19 Distribution bar chart of religious belief and education.(level of education: junior high school and below-1; high school-2; undergraduate-3; master's degree-4; doctoral graduate student-5; excluding data with “other” level of education; religious belief: 1-no religious belief; 2-religious belief)

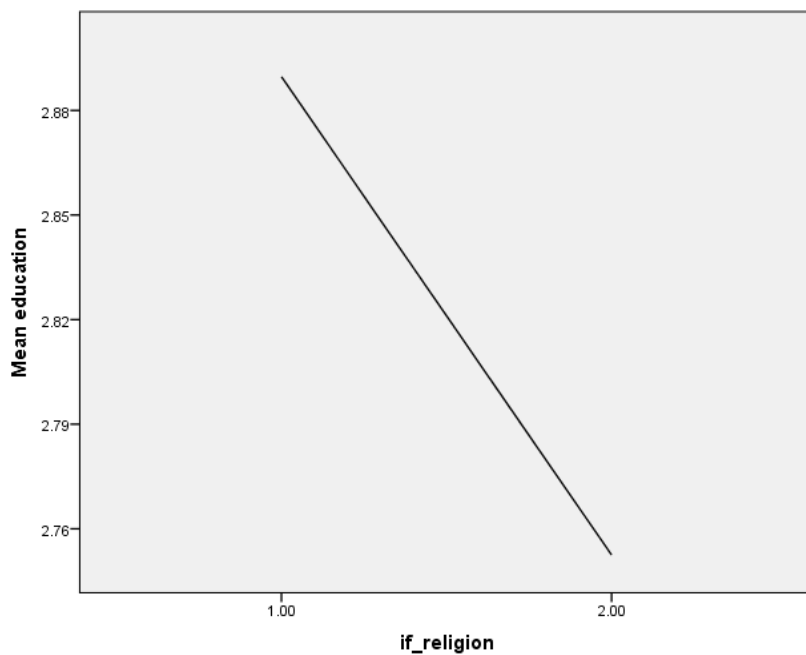


Fig. 20 comparison of the average level of education of religious belief groups (level of education according to junior high school and below-1; high school-2; undergraduate-3; master's degree-4; doctoral student-5 points, excluding data with “other” educational level; horizontal coordinates 1-no religious belief; 2-religious belief)

However, in terms of acceptance, although table 16 shows that the Mann-Whitney U test results at 95% confidence intervals can lead to conclusions with significant impact, its significance value is 0.043, which is already very close to the set standard 0.05. If the test standard is improved, the opposite conclusion can be drawn. In fact, as can be seen from figure 17, religious beliefs do not have much influence on acceptance, probably because Chinese religions, influenced by Chinese culture, are more secular and pragmatic than Western religious figures who strongly believe that “gene editing violates the laws of nature “, that” gene editing does not respect the rights of other creatures “and that” gene editing is the role of man in God “.

(5) The Impact of the Level of Education

Excluding the “other” data from the educational level, the Kruskal-Wallis test was carried out on the 95% confidence interval, and the results are shown in Table 17. 19.

Table 17 Cognitive level-level of education Kruskal-Wallis test

Total N	1,234
Test Statistic	93.610
Degrees of Freedom	4
Asymptotic Sig. (2-sided test)	.000

Table 18 level of acceptance-level of education kruskal-wallis test

Total N	1,234
Test Statistic	12.566
Degrees of Freedom	4
Asymptotic Sig. (2-sided test)	.014

Table 19 results of Kruskal-Wallis test for educational level grouping

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of education.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of education.	Independent-Samples Kruskal-Wallis Test	.014	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

According to the results of kruskal-wallis test, on the 95% confidence interval, the educational level has a significant effect on cognitive level and acceptance, but the effect on cognitive level is more significant. When the confidence interval is adjusted to 99%, it can be concluded that the level of education has no significant effect on the degree of acceptance.

As can be seen from figure 21, the higher the level of education, the higher the level of cognition of gene editing, but there is no significant change in acceptance. Having a higher level of education does not mean that people will fully accept gene editing. On the contrary, higher education may make them have more consideration about the safety risks and ethical and social problems of gene editing, so the level of acceptance has not improved significantly with the improvement of education level.

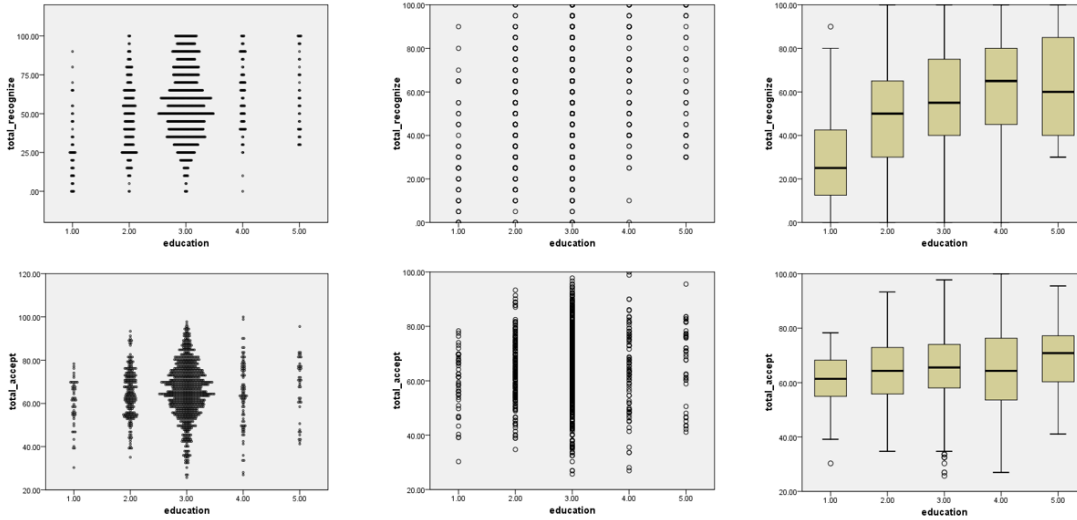


Fig. 21 Impact of Educational Level on Cognitive and Acceptance Levels

Similar conclusions can be drawn from the regression analysis results of figures 22, 23 and 20, and table 21.

Table 20 Regression of Cognitive level-Educational level

Model Summary and Parameter Estimates

Dependent Variable: total_recognize

Equation	R Square	Model Summary			Sig.	Parameter Estimates	
		F	df1	df2		Constant	b1
Linear	.070	93.276	1	1232	.000	30.600	8.513
Logistic ^a	.	.	.	.	.	.	.

The independent variable is education.

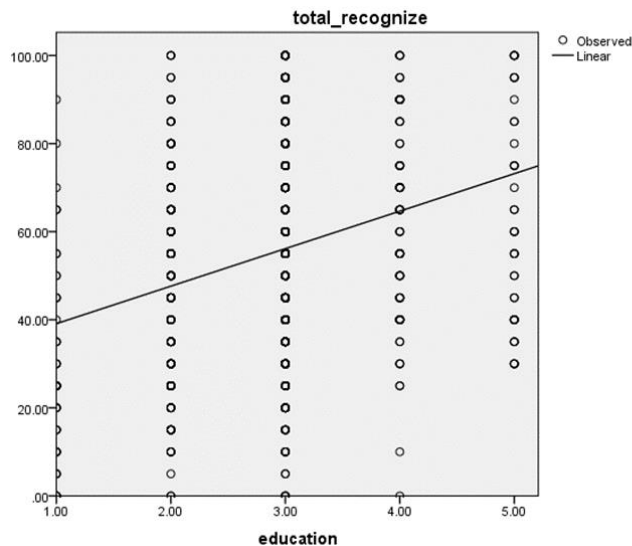


Fig. 22 Regression of Cognitive Level-Educational Level

Table 21 Regression of Acceptance Level-Educational Level

Model Summary and Parameter Estimates

Dependent Variable: total_accept

Equation	R Square	Model Summary			Sig.	Parameter Estimates	
		F	df1	df2		Constant	b1
Linear	.005	5.619	1	1232	.018	61.966	1.162
Logistic ^a	.003	3.176	1	1232	.075	.016	.986

The independent variable is education.

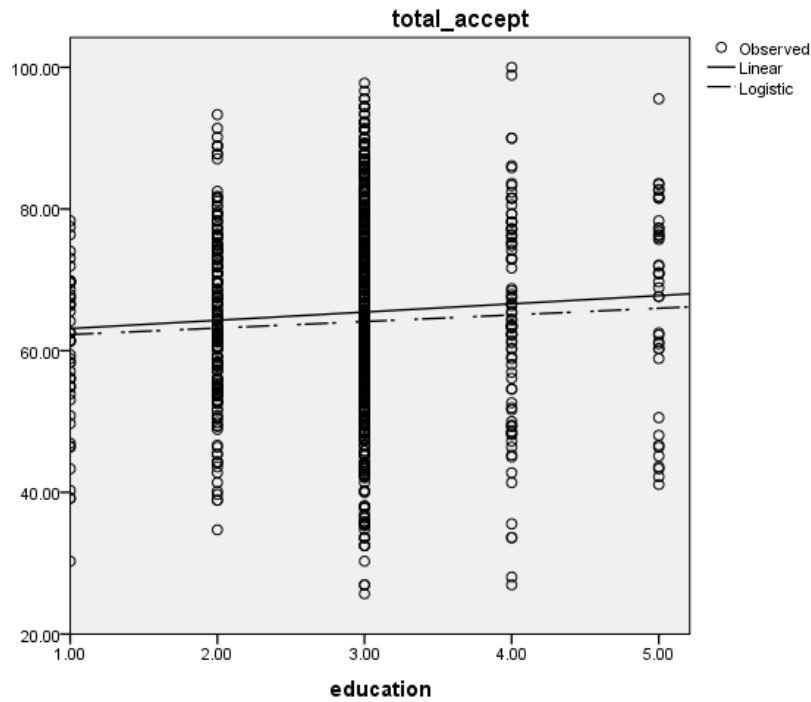


Fig.23 Regression of Acceptance Level-Educational Level

(6) The Impact of Income

The income groups were tested by Kruskal-Wallis at 95% confidence interval, and the results were shown in Table 22-24. It can be seen that income has a significant effect on cognitive level and acceptance in 95% confidence interval.

Table 22 Cognitive level-Income Kruskal-Wallis Test

Total N	1,306
Test Statistic	229.623
Degrees of Freedom	5
Asymptotic Sig. (2-sided test)	.000

Table 23 Acceptance-Income Kruskal-Wallis Test

Total N	1,306
Test Statistic	100.351
Degrees of Freedom	5
Asymptotic Sig. (2-sided test)	.000

Table 24 Income Grouping Kruskal-Wallis Test Results

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of income.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of income.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

However, from the distribution shown in figure 24, it is found that the effect of income on cognition and acceptance is not regular. From the regression results shown in figure 25, 26, we can even draw the abnormal conclusion that income level is negatively correlated with cognition and acceptance.

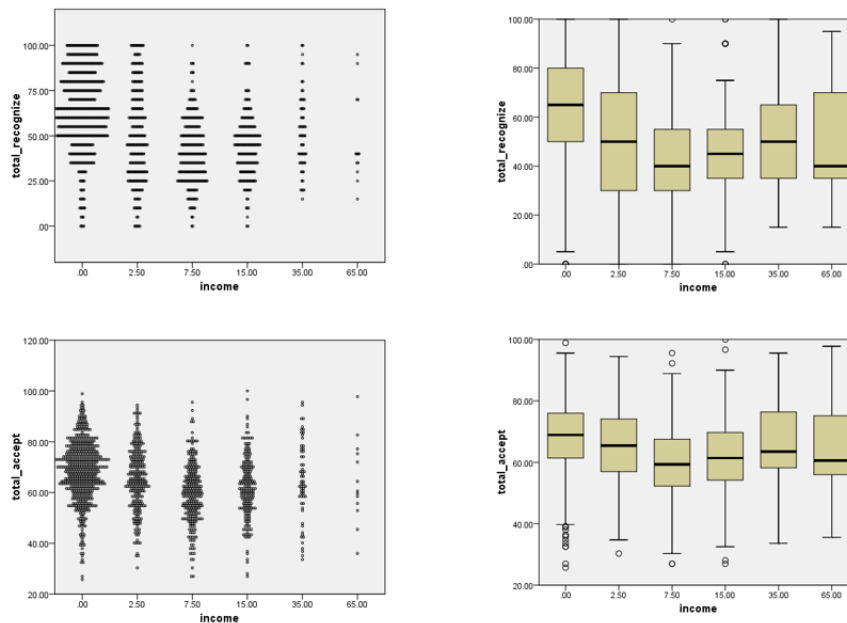


Fig. 24 Effect of Income on Cognition and Acceptance (income replaced by group median)

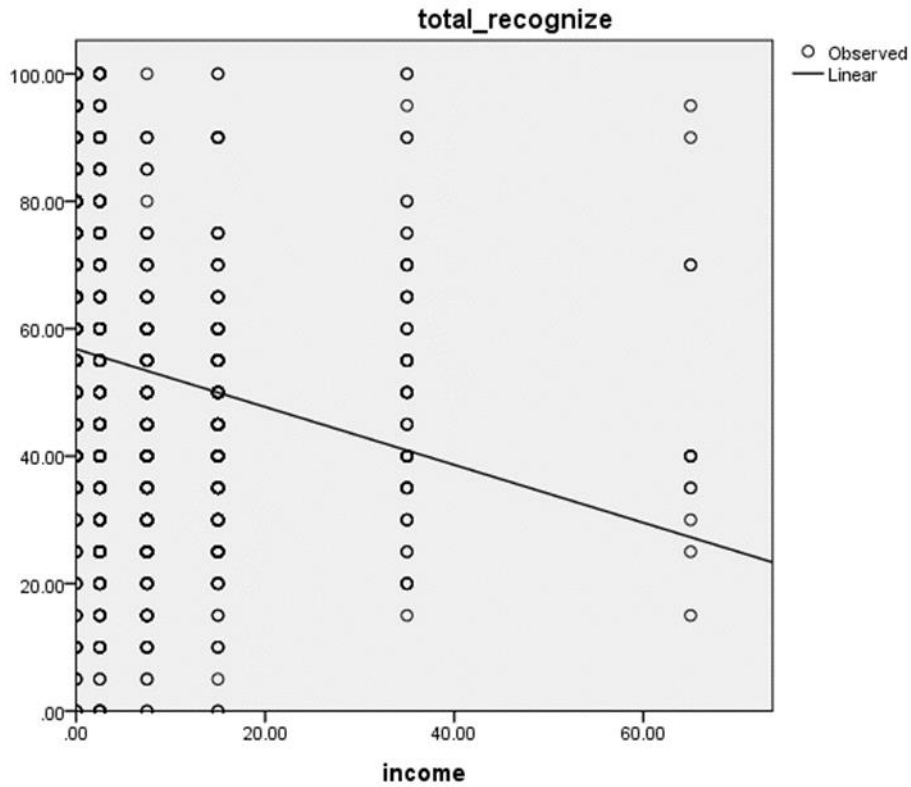


Figure 25 Cognitive level-Income Regression (income replaced by group median)

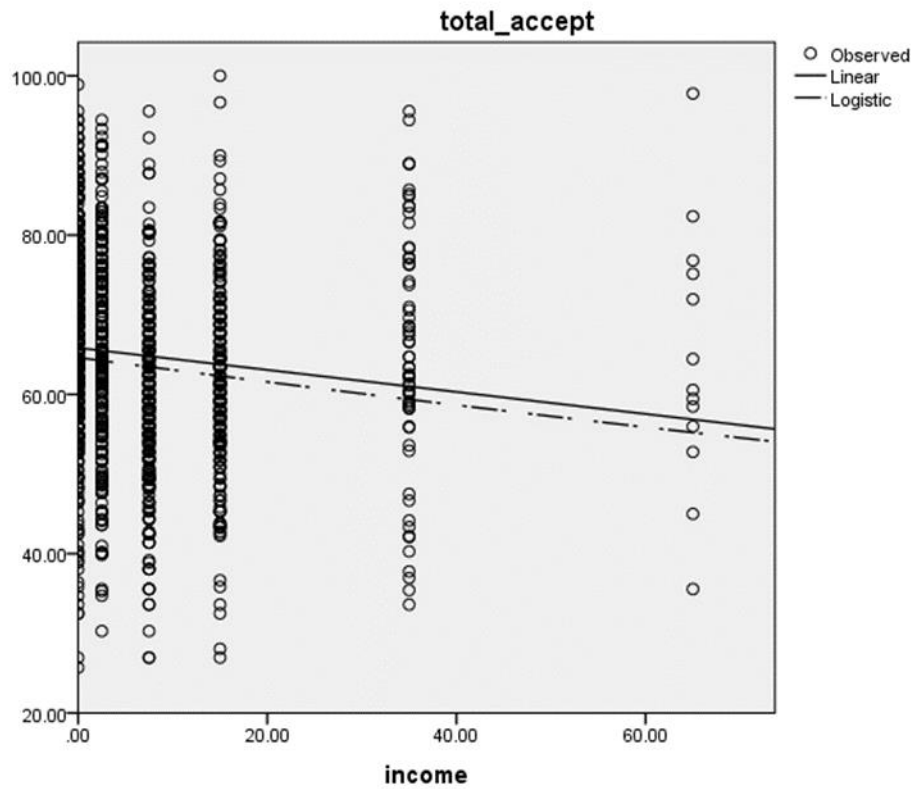


Figure 26 Acceptance-Income Regression (income replaced by group median)

After analysis, this kind of anti-common sense result may be because the low-income group includes a large number of school students, they have a high level of education, the current income level can not measure their future income level in society. Therefore, after excluding the “students in school”, the analysis and drawing were carried out again.

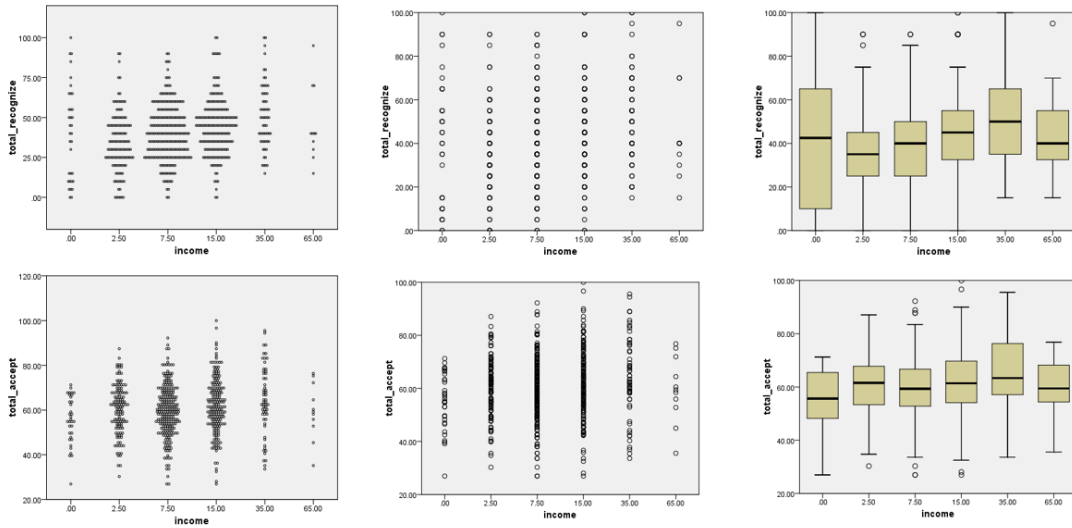


Fig. 27 the effect of income on cognitive level and acceptance after excluding students in school

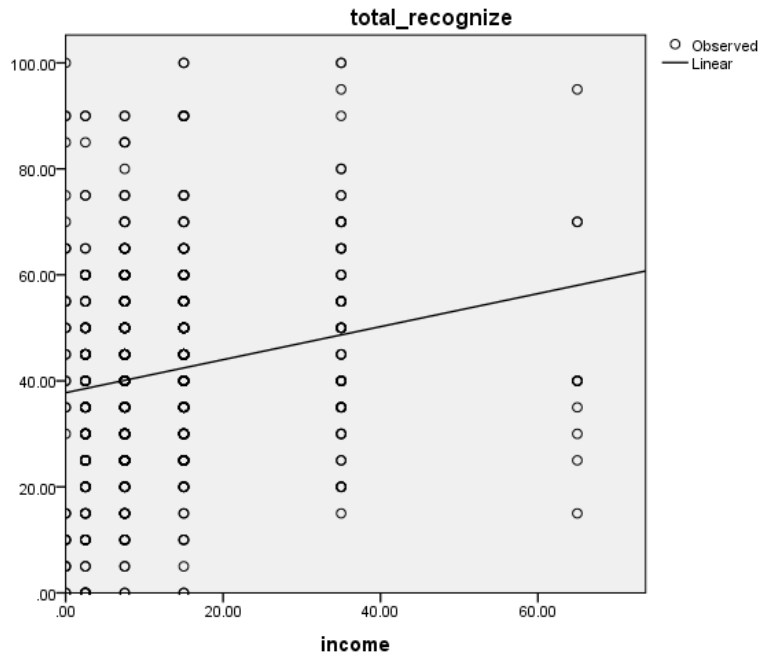


Fig. 28 Cognitive level-income regression after excluding students (income replaced by group median)

Table 25 Cognitive level-income regression after excluding students in school

Model Summary and Parameter Estimates

Dependent Variable: total_recognize

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.034	22.821	1	653	.000	37.766	.312
Logistic ^a	.	.	.	.	.	.	.

The independent variable is income.

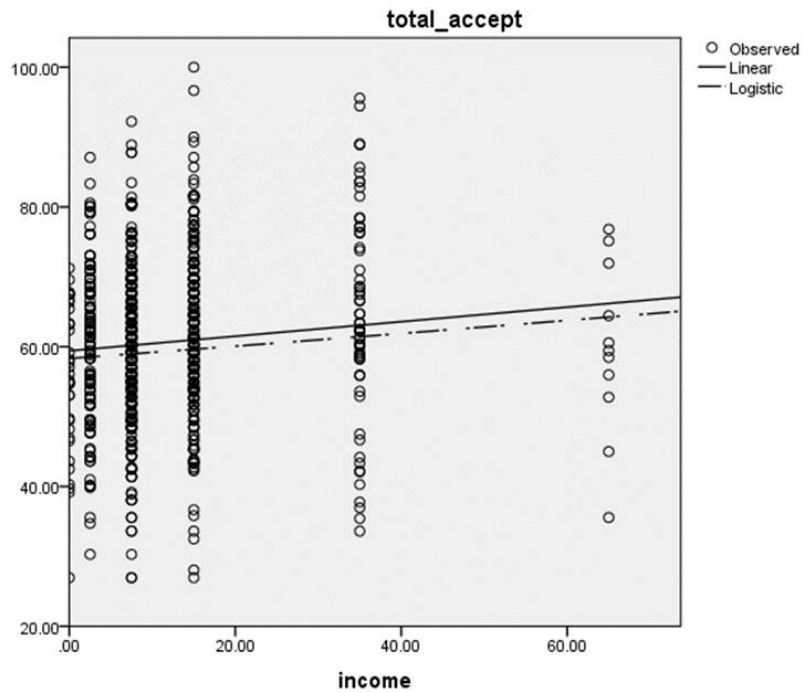


Figure 29 degree of acceptance after excluding school students-income regression (income replaced by group median)

Table 26 Relevance of Acceptance - Income Regression(after excluding school students).

Model Summary and Parameter Estimates

Dependent Variable: total_accept

Equation	R Square	Model Summary				Parameter Estimates	
		F	df1	df2	Sig.	Constant	b1
Linear	.010	6.291	1	653	.012	59.414	.104
Logistic ^a	.006	4.177	1	653	.041	.017	.999

The independent variable is income.

Figures 28 and 29 show that after excluding the students in school, there is a positive correlation between cognition and acceptance and income, which is consistent with our common sense experience. The reason for this positive correlation can be attributed to the higher the income, the higher the level of education, as shown in figure 30, 31.

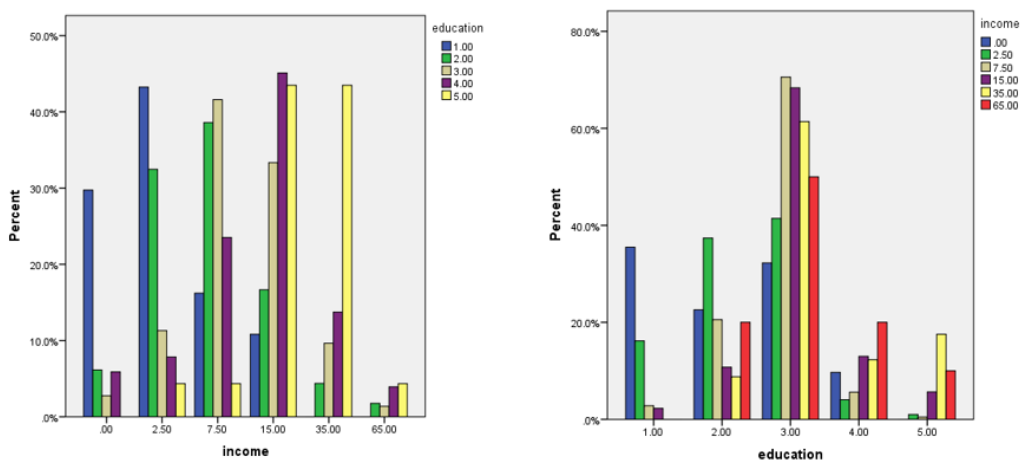


Figure 30 Distribution of Income-level of education

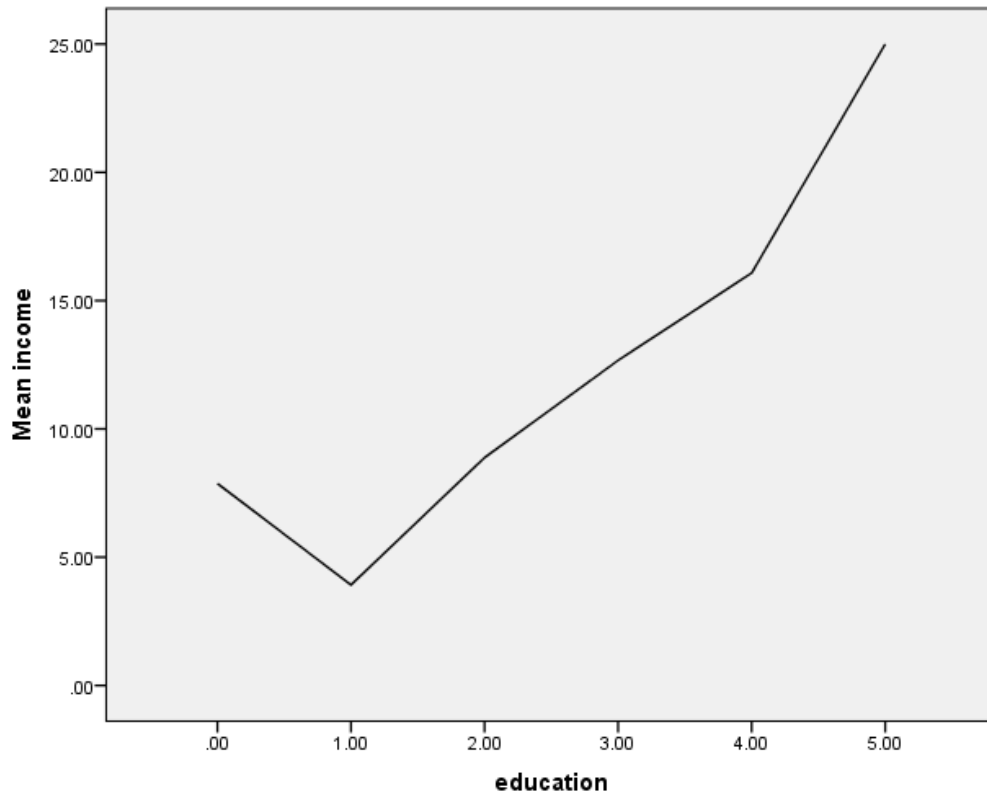


Figure 31 Broken Line Chart of Average Income - Educational Level

(7) The Impact of Occupation

In the design of the questionnaire, in order to facilitate the selection of subjects, we divided the occupations into 14 categories according to the relevant classification methods of the National Bureau of Statistics. In the analysis of data, for convenience, occupations are reclassified into 1-students; 2-”white-collar workers” [including government / agency cadres / civil servants, business managers (including grass-roots and middle and senior managers), ordinary staff (office / office staff), professionals (e.g. doctors / lawyers / sports / journalists / teachers / researchers, etc.); 3-”blue-collar workers” [including ordinary workers (such as factory workers / manual workers, etc.), commercial service workers (such as sales staff / shop staff / waiters, etc.), self-employed / contractors, agricultural, forestry, animal husbandry and fishing workers]; 4-other [including freelancers, retirement, temporary absence of employment, others].

A Kruskal-Wallis test was performed for occupational groupings at 95%confidence intervals, and the results are shown in Table 27-29. It can be seen that occupation has a significant influence on cognitive level and acceptance at 95%confidence interval.

Table 27 Cognitive level-Occupational Kruskal-Wallis Test

Total N	1,306
Test Statistic	405.265
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	.000

Table 28 Acceptance-Occupation Kruskal-Wallis Test

Total N	1,306
Test Statistic	171.266
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	.000

Table 29 Results of Kruskal-Wallis Test for Occupational Groups

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of position.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of total_accept is the same across categories of position.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

As shown in figure 32, it can be seen that the students have the highest cognitive level and acceptance, which may be due to the fact that the students are closer to the forefront of science and technology. Because of the different characteristics of work, the overall education level of “white-collar workers” is also higher than that of “blue-collar workers” (Fig. 33), so the cognitive level of “white-collar workers” is higher than that of “blue-collar workers”. However, in terms of acceptance, except for the students in school, the gap between other occupations is not large.

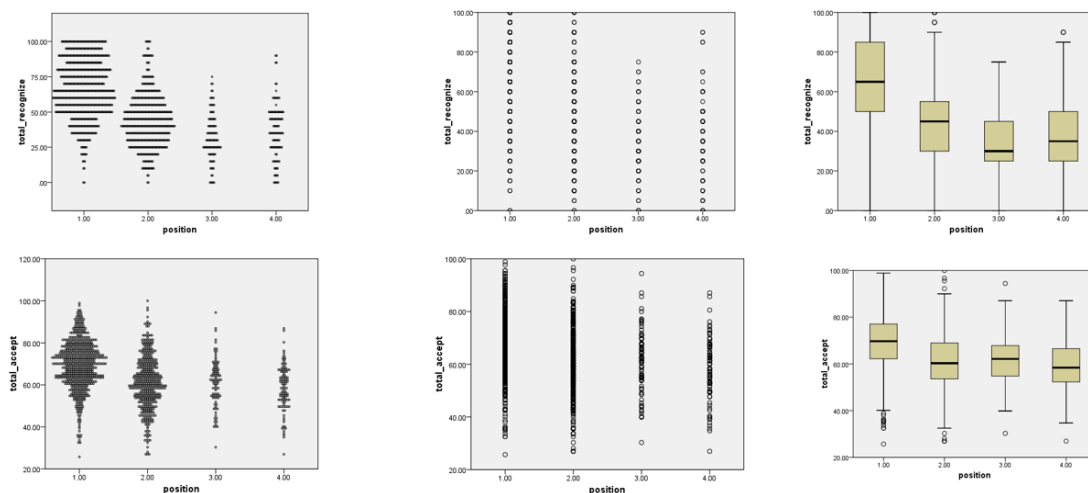


Figure 32 Impact of Occupation on Cognition and Acceptance

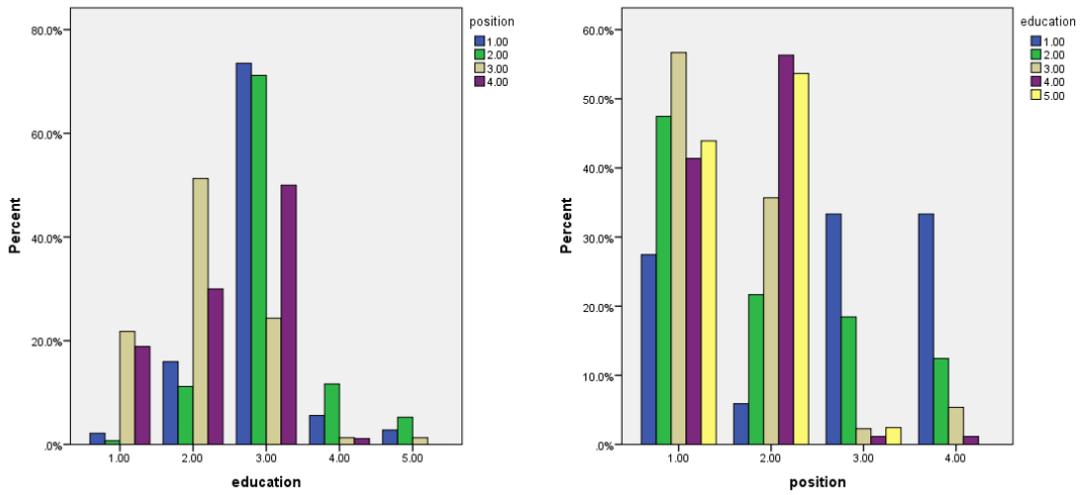


Figure 33 Distribution of occupation level- education level

(8) Impact of the health of relatives and friends

After excluding the “unclear” data, the distribution map is shown in figure 34.

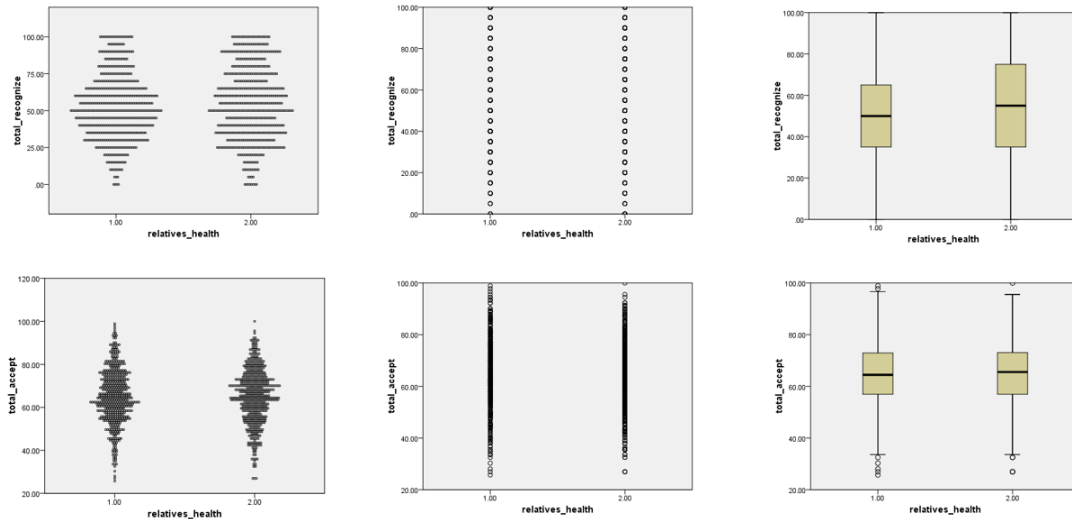


Fig. 34 effects of whether there are “major diseases” among relatives and friends on cognition and acceptance (1 for “yes” and 2 for “no”)

From figure 34, it can be seen that whether their relatives and friends suffer from the major diseases listed in the National Major Disease Insurance do not have much impact on their overall perception and acceptance of gene editing technology. The Mann-Whitney U test results shown in Table 30 and Fig. 35 also confirm this—at 95% confidence interval, this variable has no significant effect on cognition and acceptance. The role of this influencing factor can only be reflected after subdividing the genes of different objects, as detailed in part (IV) of the analysis.

Table 30 Mann-Whitney U test for relatives and friends with or without “major diseases”

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of total_recognize is the same across categories of relatives_health.	Independent-Samples Mann-Whitney U Test	.208	Retain the null hypothesis.
2	The distribution of total_accept is the same across categories of relatives_health.	Independent-Samples Mann-Whitney U Test	.381	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

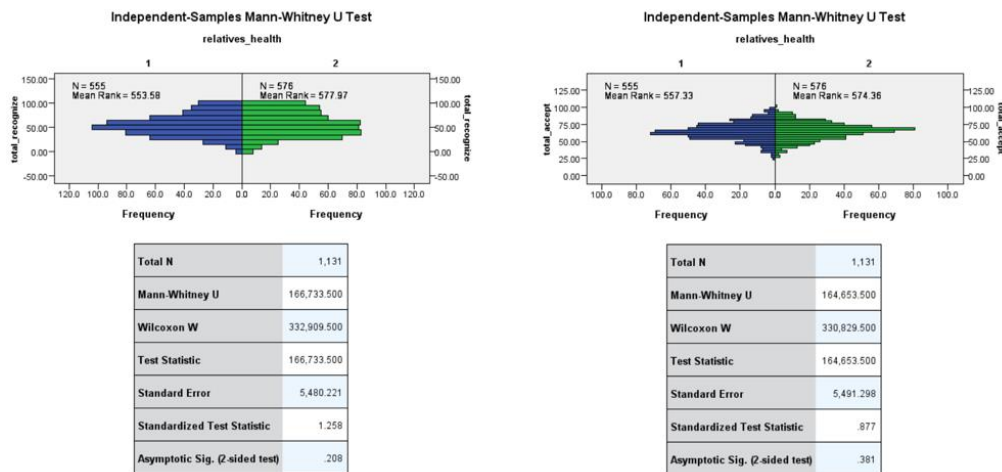


Fig. 34Mann-Whitney U test for relatives and friends with or without “major diseases”

4. Differences in Public Acceptance of Gene Editing among Different Objects of Application

(1) Overall situation

Gene editing techniques can be used in microorganisms, non-edible plants, non-edible animals, food, human somatic cells (gene therapy) and human embryos. There are significant differences in public attitudes towards gene editing techniques in different ranges of use.

According to the results of question 1 of the second part of the questionnaire, the average acceptance degree was calculated by “1-Resist; 2-Mainly approve; 3-Completely accept; 4-Neutral./It doesn't matter.”, as shown in figure 35. On the whole, the public has the highest acceptance of microbes and non-edible plants. In traditional Chinese culture, microbes and plants are not actually regarded as “life” equivalent to human beings and other animals. Religious followers “not killing” requires “abstinence from meat”, but can be vegetarian. Therefore, in the eyes of most people, genetic editing of microbes and “non-edible plants” does not have any ethical issues such as “violating the laws of nature”, and seems to have a long way to go with

their own lives, and does not pay attention to issues such as ecological security. Because animals are considered to have feelings, are more “spiritual”, and are closer to people, gene editing of animals seems to have more emotional and ethical problems, so it is slightly less acceptable. However, in the atmosphere of secularization and pragmatism in China, although a small number of “animal conservationists” will think that gene editors are guilty of “violating animal rights”, most people think that “talent is the ultimate goal”, as long as it is beneficial to human beings, so the acceptance of gene editing of “non-edible animals” is also very high. Because gene editing of human somatic cells has no genetic effect and has the application space of gene therapy for diseases, it is regarded as a gospel by most people. Although it is the object of human beings, the degree of acceptance is very high. But for food genetic editing, affected by the previous wave of genetically modified food, most people generally worry that it is harmful to the health, the degree of acceptance is very low. Gene editing of human embryos is not only at great technical risk, but also involves complex ethical and social problems, coupled with the “He Jiankui incident”, the degree of acceptance is the lowest.

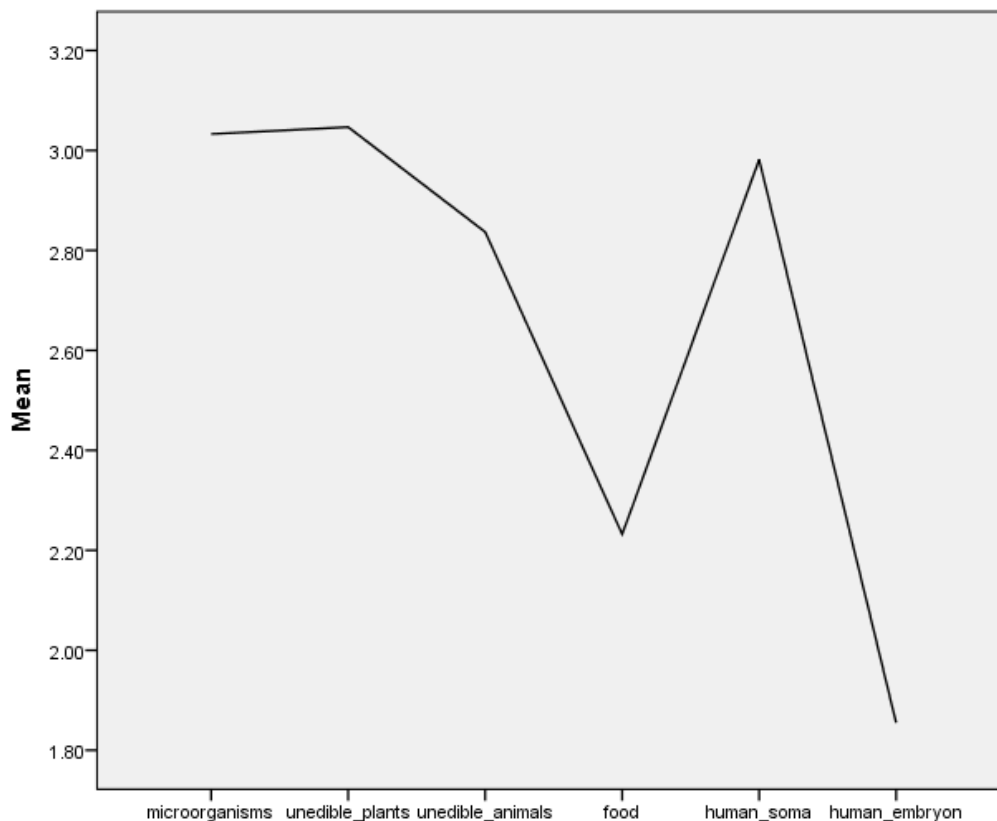


Fig. 35 Average Public Acceptance of Gene Editing Techniques for Different Objects

(2) Influence of variables such as age, sex, level of education, residence, religious, etc.

Figure 36 shows the different attitudes of gene editing techniques to different objects in different age groups. As you can see, the biggest difference lies in the attitude towards gene editing edible organisms. Because of the high level of education and more open thought, the acceptance of gene editing edible organisms is very little different from that of non-edible animals and plants, while the older population is quite resistant to gene editing edible organisms. In the age groups of 26-40 and 41-50, the acceptance of gene editing edible organisms is even lower than that of gene editing human embryos.

Figure 37 shows more vividly the distribution of attitudes towards the use of gene editing techniques in food at different ages.

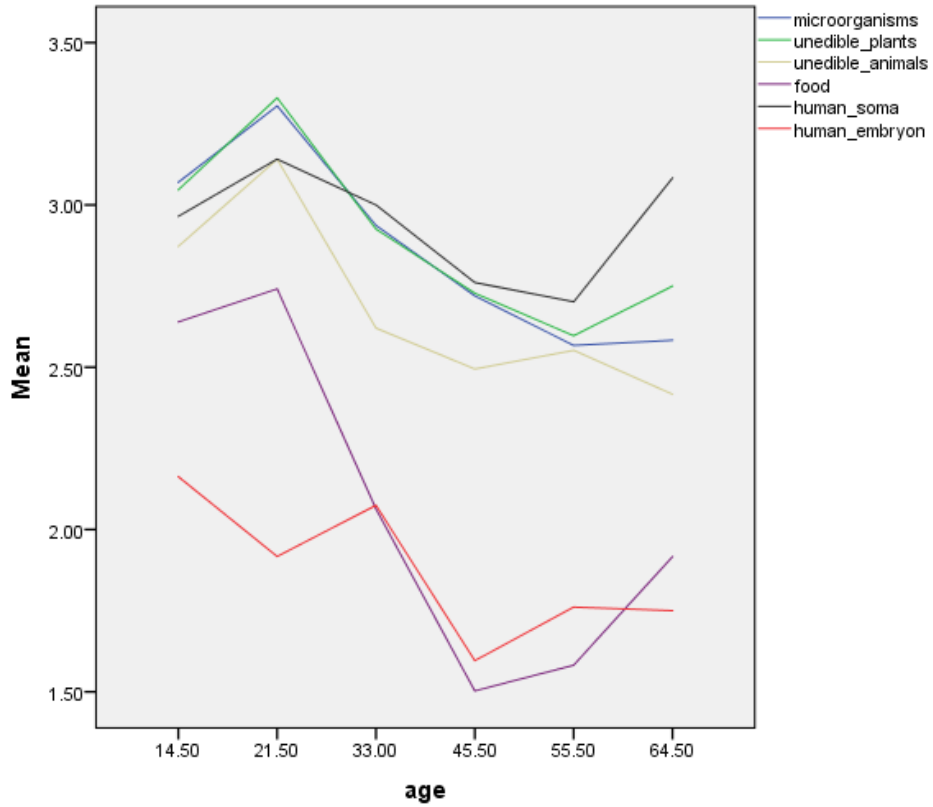


Fig. 36 attitudes of different age groups towards gene editing for different objects (age replaced by group median)

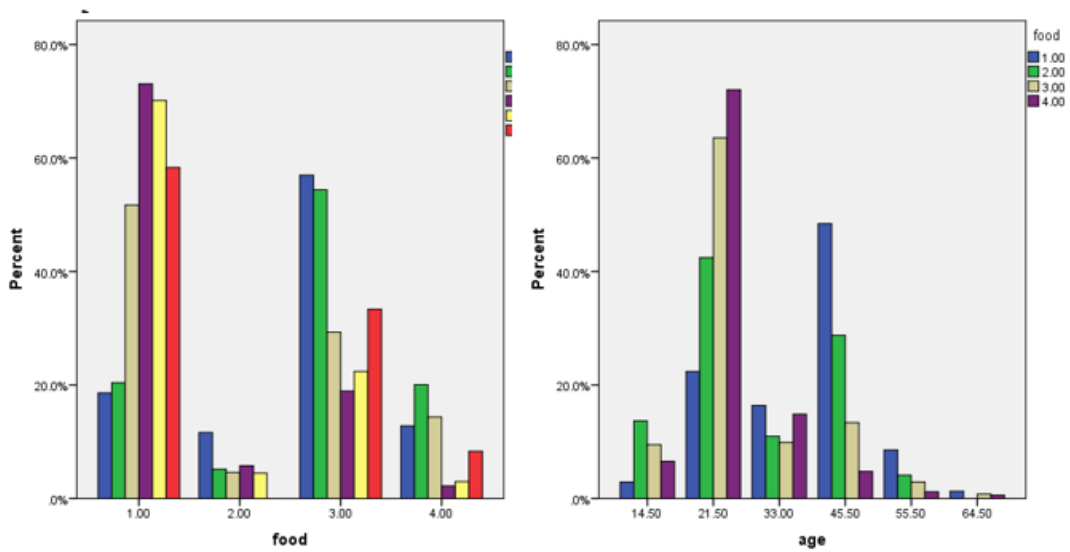


Fig. 37 Distribution of attitudes towards the use of gene editing techniques in the food field at different ages (1-Resist; 2-Neutral./It doesn't matter.; 3-Mainly approve; 4-Completely accept)

In accordance with the law of total acceptance, as shown in Fig. 38, for gene editing of different subjects, the acceptance of men was higher than that of women. The obvious gap between gene editing in human embryos, gene editing in food and gene editing in other fields is clearly visible.

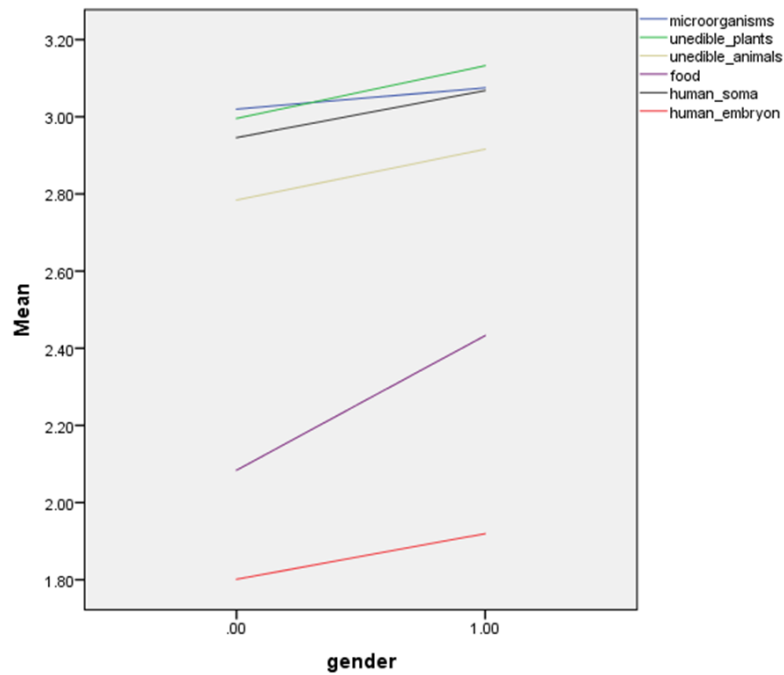


Figure 39 attitudes of different genders towards gene editing of different objects (0-female; 1-male; excluding “Inconvenient to disclose”)

Figure 40 shows that the acceptance of gene editing for food in large cities is significantly higher, while that of human embryo gene editing is lower. As a result, people in big cities show “three ladders”—gene editing for human embryos, gene editing for food, and gene editing for other objects are significantly different, while small and medium-sized cities and rural areas are “two extremes”—gene editing for human embryos and food is very different from other types of gene editing. Because small and medium-sized urban residents know more than rural residents, they are more worried and less receptive to human embryo and food gene editing.

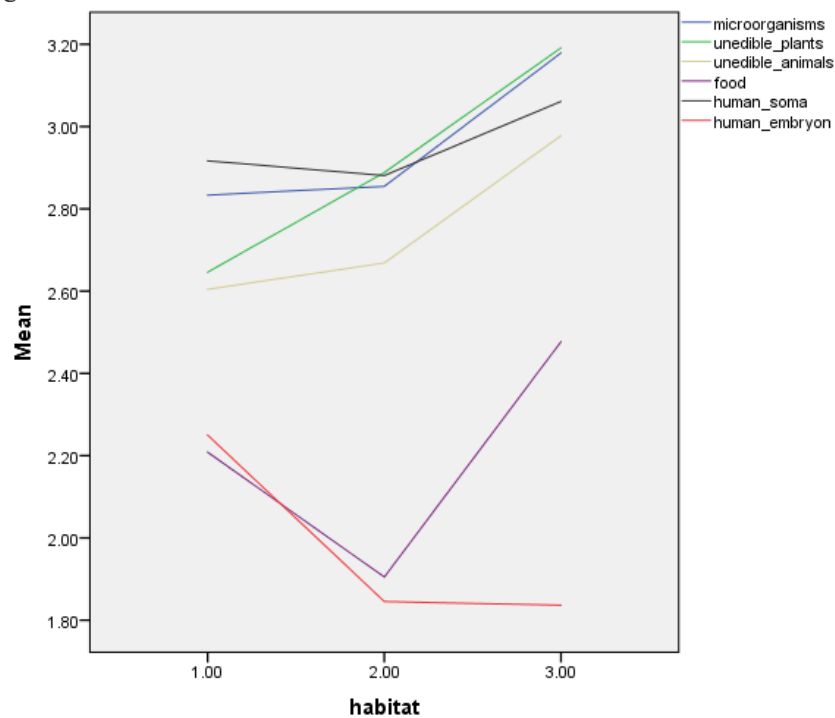


Figure 40 attitudes towards gene editing for different objects in different places of residence (1-rural; 2-small and medium-sized cities; 3-large cities)

The higher the level of education, the lower the acceptance of gene editing in human embryos, and the higher the acceptance of other types of gene editing, as shown in figure 41.

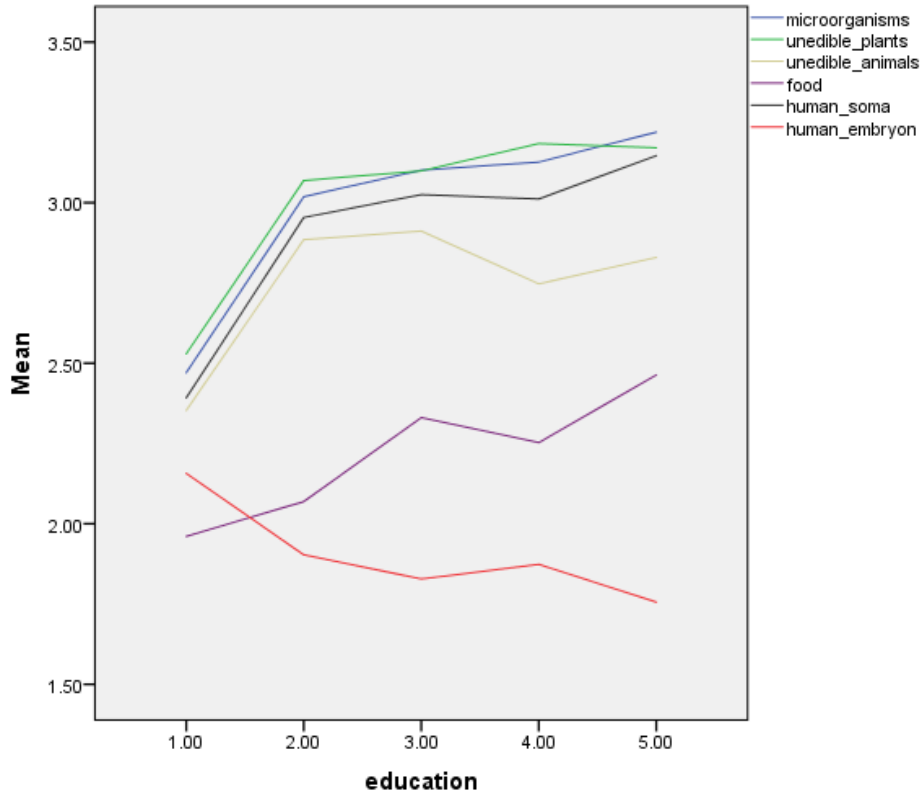


Fig. 41 attitudes towards gene editing for different objects at different levels of education (1-junior high school and below; 2-high school; 3-undergraduate; 4-master's degree; 5-doctoral student; excluding "others")

Although whether relatives and friends have significant disease on the overall acceptance of no significant impact, after the gene editing of different subjects, it can be seen that the acceptance of human body cell gene editing(gene therapy)is increased by the public after the family and friends have major diseases, but the acceptance of gene editing in food field is reduced. This may be because people are more likely to have new treatment techniques to help their relatives overcome the disease after having a major disease. In the investigation, more than one person put forward the claim that the current high incidence of cancer and other diseases is related to transgenic food. As a result, people with family and friends with major diseases are more difficult to accept gene editing in food.

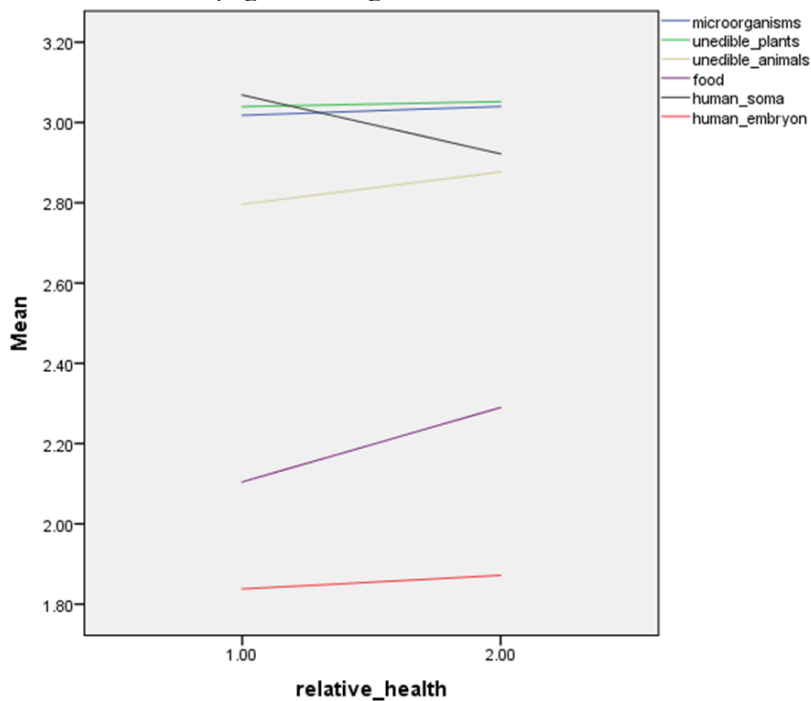


Fig. 42 the effect of whether relatives and friends suffering from major diseases on the attitude of gene editing in different objects (1-yes; 2-none; excluding "unclear")

The influence of religion, on the other hand, is very interesting. In part (III), it can be seen that because religion is secularized in China, the existence of religious belief has no significant effect on the general acceptance of gene editing by the public. But according to figure 43, people with religious beliefs are less receptive to genetic editing of microbes, non-edible plants, non-edible animals, food and human somatic cells. Although the secularization and pragmatism of religious beliefs in China are obvious, religious followers still hold more views such as “gene editing is contrary to the laws of nature” than those without religious beliefs, so they are less acceptable, but for embryonic gene editing, the acceptance of religious followers is higher than that of those without religious beliefs.

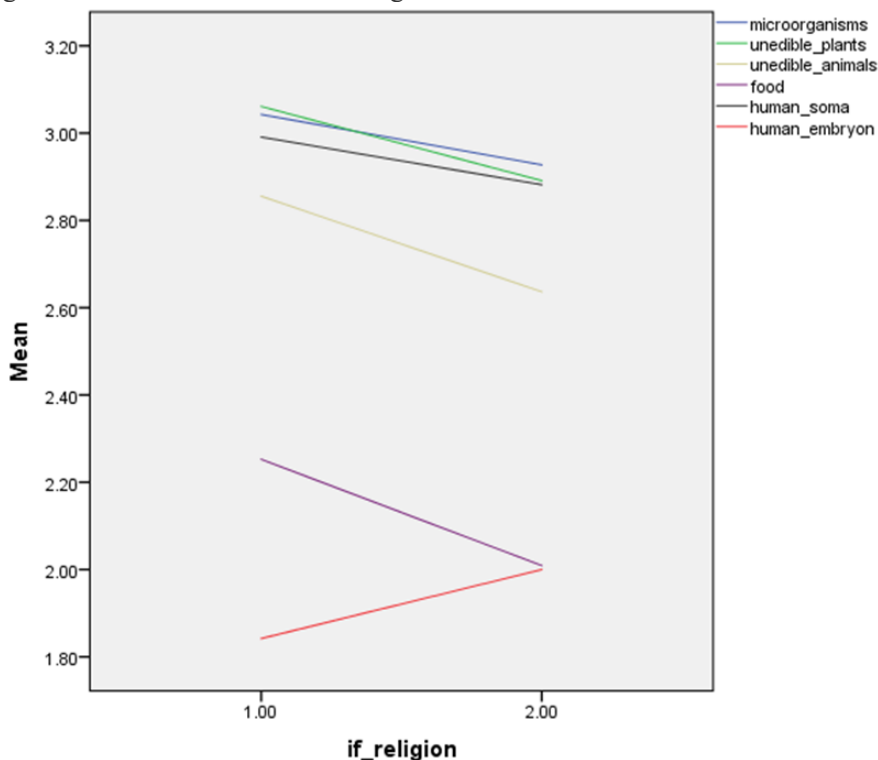


Fig. 43 the influence of religious belief on the attitude of Gene Editing in different objects (1 none;2 Yes).

5. Different Considerations for the Development of Gene Editing Technology

In the selection and ranking problem, three factors of technical safety, ethics and economic cost are given, and the subjects choose the factors that need to be considered in the development of gene editing technology and sort them. For the data results, select the number three points side by side, the second point by side, the third point by side, and the number 0 points that are not selected. The comprehensive score is calculated, and the results are shown in figure 44.

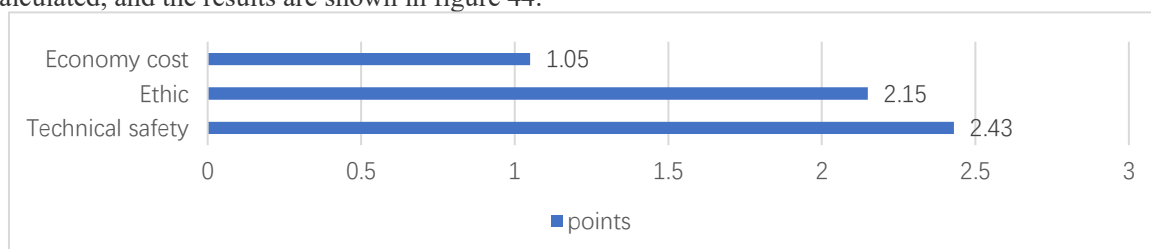


Fig. 44 Comprehensive Score of Factors Considered in the Development of Gene Editing Technology

(1) Technical security issues

As can be seen from figure 44, the most important issue for the public is technological safety, which is a general public concern about emerging technologies. Secondly, because gene editing technology involves human transformation of organisms and even human beings themselves, the public is also very concerned about its ethical issues. Relatively little attention is paid to the economic cost of technological development.

As shown in figure 45, most people agree with the statement that “the biggest problem of gene therapy at this stage is safety”, confirming the results of the sequencing problem.

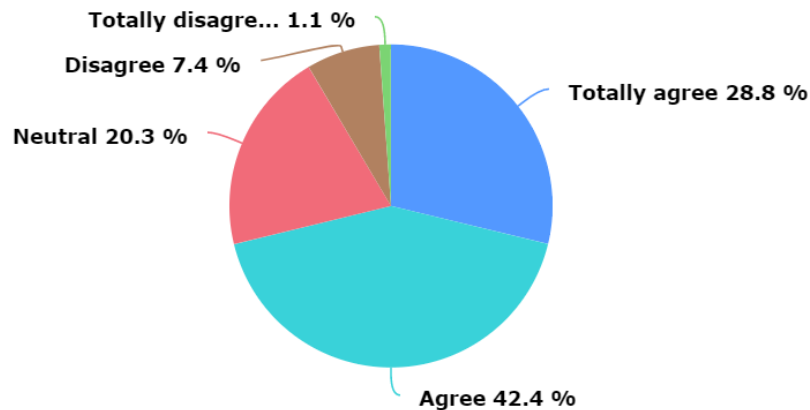


Fig. 45 expression identity distribution of “the biggest problem in gene therapy at this stage is safety”

As shown in figure 46, an analysis of the public's acceptance of gene editing for human somatic cell disease and the expression “if gene therapy is mature and safe, I am in favor of its application “(Q8 represents the second part of the questionnaire, question 2, expression 8) shows that the public's acceptance has increased significantly with the premise that “gene editing technology is mature and safe “. More than 70 percent of those who had previously had a “boycott” attitude towards gene editing turned to neutrality or even support, while more than 40 percent of those who had a “neutral, indifferent” attitude turned to consent to the promotion of gene therapy, with the exception of about half who remained neutral. This test shows that the safety of gene editing is a key factor restricting its development.

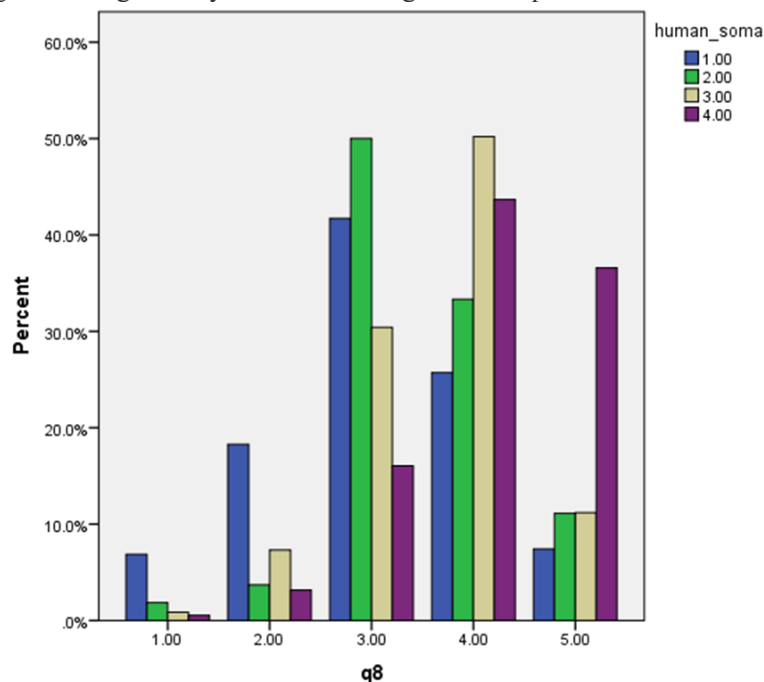


Fig. 46 effect of technical safety issues on gene editing therapy(Q8 is expressed as “if gene therapy is mature and safe, I agree with its promotion and application”; horizontal coordinates 1-5 are: completely dissenting, neutral, agreeing, very agreed; category 1-4 in turn: boycott, neutrality, basic recognition, full acceptance)

(2) Ethical problems

For some people, gene editing or at least gene editing of some creature is still unacceptable when technology is mature. Their consideration is ethical.

An important ethical consideration is whether gene editing “violates the rights of other animals.” The vast majority of the public does not agree with these criticisms, and the public holds the view that “man is the end”, which is acceptable as long as it can benefit mankind. It can be seen from the acceptance of gene editing of different objects in (IV). The selection of “I can accept gene editing techniques that act on non-human bodies” (figure 47) shows that more than 50% of the public supports the modification of other biological genes because of the need for human production and life.

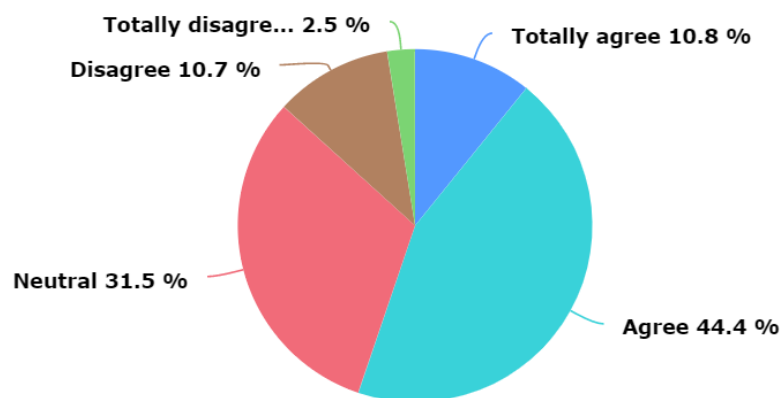


Figure 47 expression acceptance distribution of “I can accept gene editing techniques that act on non-human bodies”

Another ethical question is whether gene editing is “against the laws of nature” and whether man is playing the role of God. The questionnaire was tested with the question of “modified genes are contrary to the law of nature, but there must be no good results in the end” (the sixth expression of the second question of the second part of the questionnaire is replaced by Q6). The overall distribution is shown in figure 48.

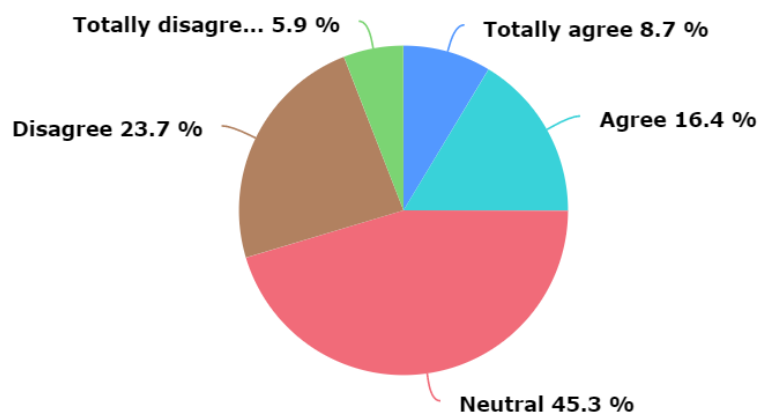


Fig. 48. The expression acceptance distribution of “modified genes are contrary to the laws of nature and certainly have no good results in the end”.

As can be seen from figure 48, only a little more than 1/4 people explicitly object to this claim, nearly the average person is neutral, and about 1/4 people explicitly support it, saying that genetic editing is contrary to the laws of nature. It shows that this problem is indeed an ethical issue of public concern.

Make an interactive analysis of the position of this issue with the existence of religious beliefs, as shown in figure 49. As can be seen from figure 20, people with religious beliefs do agree more with the statement that “genetic editing is contrary to the laws of nature.”

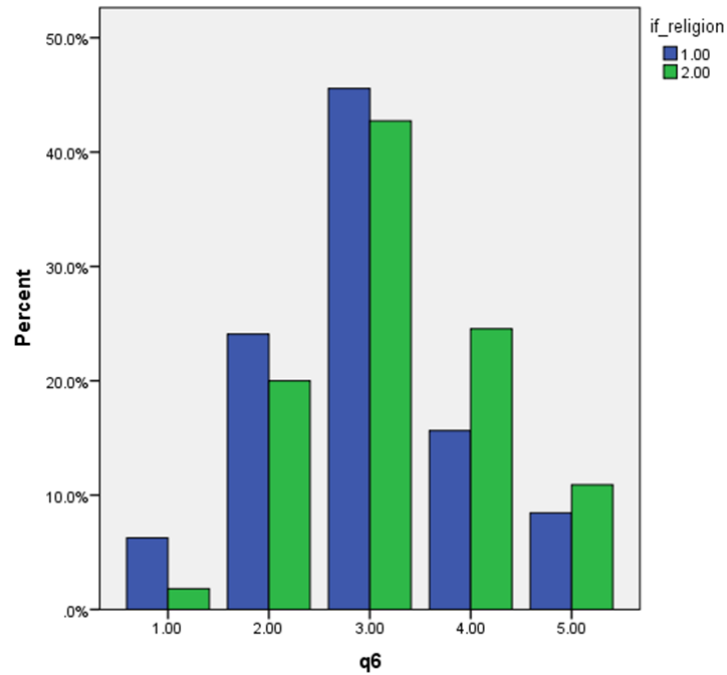


Fig. 49 the distribution effect of religious belief on the expression of “genetically modified genes that are contrary to the laws of nature and ultimately without good results” (horizontal coordinates 1-5 in turn are totally disagree, disagree, neutral, agree, totally agree; category 1-no religious belief, 2- have religious belief)

The third focus of the ethical problem of gene editing is gene editing of human embryo. In particular, the “He Jiankui incident” made this point become the focus of public discussion after dinner. In addition to the risk of gene editing, human embryo gene editing has caused more ethical controversy because it directly targets human beings and has genetic effect. Parents may not choose to modify their child's genes even if parents consider that such a modification is beneficial to their children. “if a child has a congenital defect, he or she can accept gene editing with the consent of his or her parents.” see figures 50 and 51 for the distribution of approval.

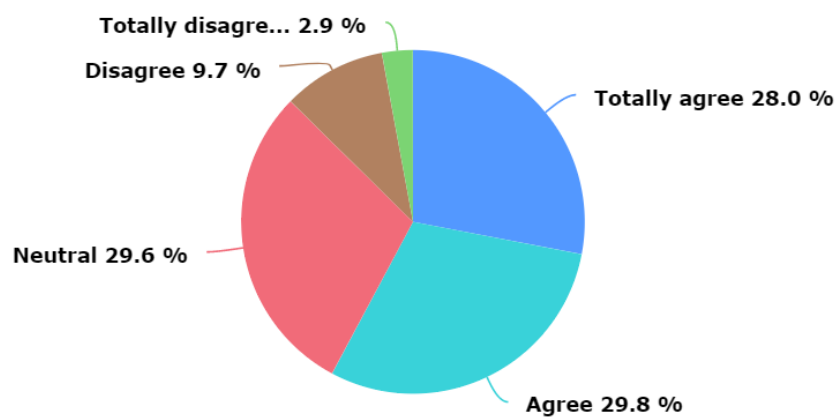


Fig. 50 expression acceptance distribution of “parents do not have the option of modifying their child's genes even if parents think that such a modification is beneficial to their children”.

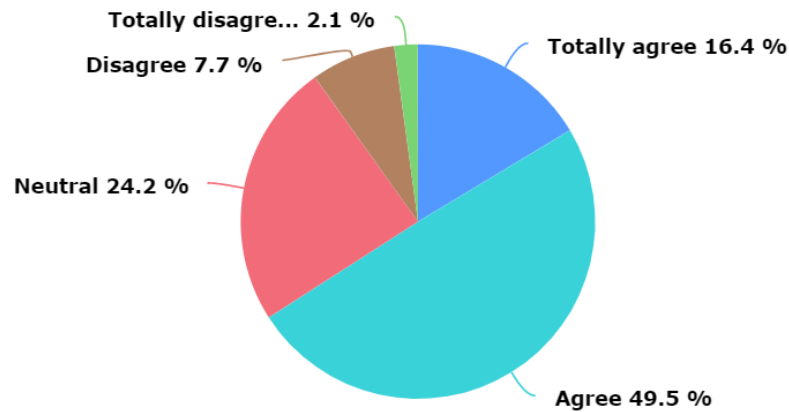


Fig.51 The distribution of acceptance of the expression “children with congenital defects can be genetically edited with parental consent.”

In figure 50, more than half agree that “even if parents think the modification is good for their children, parents can't choose to modify their child's genes,” but in figure 51, more than half agree that “if a child has a birth defect, he or she can accept genetic editing with the consent of his or her parents.” Does this constitute a contradiction? In fact, if you look closely at these two expressions, you will find that there are subtle differences between the two expressions. The second expression is clearly limited to congenital diseases, so the majority of the public supports gene editing for the purpose of treating diseases; The first expression is “parents think it is good for their children,” which is extremely subjective. Parents infringe on their children's right to choose independently, and they may also be genetic editors for the purpose of “enhancement,” such as parents' desire for their children to be smarter, prettier, stronger, and so on. So even in countries such as China, where patriarchal influence is more far-reaching, more than 50 percent still think that even if parents think it is beneficial, Parents should not modify their children's genes casually.

(3) Economic costs

Although the comprehensive score of economic cost factors is the lowest, the acceptance of the expression that “gene editing technology will further widen the class gap in society” is indeed the highest of all the statements in question 2 of the second part of the questionnaire, as shown in figure 52. Less than 10% of the people do not agree with this view. This shows that although people will not immediately think of the high cost of gene editing, but after pointing out, they can realize that because of the high cost of gene editing technology, the rich class may make use of more capital to master the advantages of this technology and further expand the possibility of social polarization.

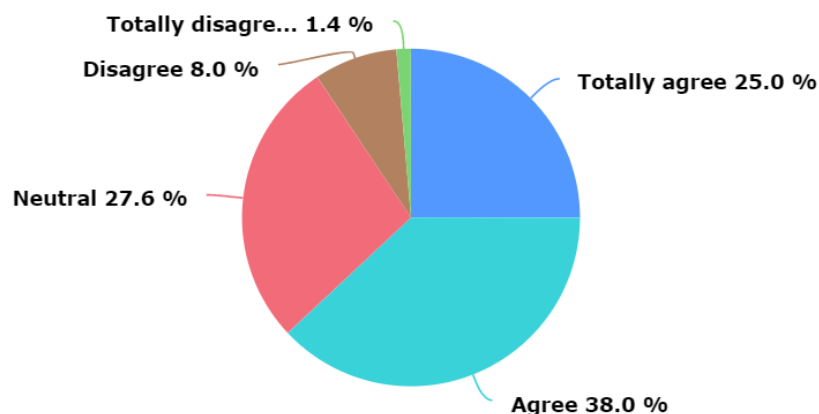


Fig. 52 recognition distribution of “genetic editing technology will further broaden the class gap in society”

IV. Qualitative Analysis of Interview Data

Interviews were conducted across the country for the public from different backgrounds. The audio recording of the interview was transcribed verbatim. More than 10000 words of interview texts have been sorted out, and the coding of the core concepts and the analysis of the text content have been carried out. Through in-depth interviews, we have an understanding of the complex views of the public on different types of gene editing and the causes of these perceptions, which are a powerful supplement to the questionnaire data.

4. The Relationship between Human and Other Species under Gene Editing Technology

Synthesize several interview texts and sort out the core code of the topic as shown in the table 31:

Table 31 Code Table of Human Genetic Editing of Other Species

Code	Descriptions	Examples of interview materials
man is the purpose / for the benefit of a man	People are the goal of our technological development. It is acceptable to modify the genes of other organisms for the benefit of mankind.	<i>I raised a pig and killed it and ate it. What's that called? Disrespect for a pig's life? To put it bluntly, people are the master of the world. I can't think from a pig's point of view.</i>
		<i>I don't eat meat, being a vegetarian. I haven't eaten meat in more than 40 years, but I never think there's anything wrong with meat eaters. You eat plants, but plants are also creatures. Therefore, I do not agree with the words "equality of all living beings".</i>
		<i>I think this is very unfair to cats, cats and dogs? (laughter) I don't have a problem with modifying people, not to mention modifying animals.</i>
safety	Humans can modify the genes of other organisms for their own development, but should also take into account some ecological security issues. But these risks can be avoided.	<i>But you do have to pay attention to what if your modified genetic outflows, which could destroy ecosystems.....Because of the complexity of ecosystem, you don't know what's going to happen outside. But as long as you promise to control it. Things do not cross with the things outside, or you only change the outside, do not change the genetic cells.</i>
diversity	People can modify the genes of other organisms, but should also take into account the diversity of genes, because some of the value of genes can only be found later.	<i>I think it can be modified. But in order to ensure species diversity, other genes can't be completely changed. It is not necessarily that the good genes found now are still good genes</i>

		<i>thousands of years later. Society is developing. At present, what human beings see is only a very shallow part.</i>
ascendancy	Man is dominant in nature.	<i>I think man is always in the dominant position in nature. The more later, the faster and faster the development of society, which is inevitable in the future. As far as I know, for example, energy is now growing faster, nuclear energy is being miniaturized, and solar energy, all of which is a major invention to change mankind. To give the simplest example, such as nuclear power plants absolutely reflect the dominance of human beings in nature.</i>
Infringe on the rights and interests of other animals (contradictory, weak tone)	It is not only considered that experimental research can be carried out, but also that it is contrary to emotion to harm the interests of other animals. But this emotion or tone is not very strong. (using "like").	<i>I think it can be studied as a technology in the laboratory. But if you pick one on the way and then let it go, I still don't agree.....This is too human-centered. Man is only a small member of nature, and it seems a little too much for his own development to harm the interests of other species.</i>
Violate the laws of nature (contradiction, weak tone).	It is considered that gene editing is contrary to the laws of nature, but the tone is not strong. (use "a bit of a feeling")	<i>It's a violation. It is a bit of a feeling that human beings forcibly rewrite the laws of nature and become beneficial to human beings.</i>
object to gene editing food	It is considered that genetic editing food is unsafe and risky.	<i>But if we eat these things, such as pigs, what genes do you change to make him grow fast? I don't think it's acceptable. I don't know if it's safe.</i>
		<i>We used to live in trenches, and very few people have diseases such as cancer. When they moved to the city, more and more people found cancer, like some children with leukemia at a very young age.....I think environmental pollution is a very important cause, but, uh, biotechnology, especially genetically modified (GM) applications, I think it still has a lot to do with. Because I don't think GM food is surly safe right now, it may have some potential hazards that we'll have to wait for decades to figure out.</i>
costs	Gene editing products may be uncompetitive because of high costs.	<i>Well, see if you have any other replacement with the same function, or a pure market behavior. I won't buy it because it's genetically edited, but I won't think it bad because it's gene edited.</i>
		<i>The future of it depends on</i>

		<i>whether it makes money, or the reaction of the market. I can even accept your operation on people. I'm sure I'll be fine with your performing an operation on animal gene.</i>
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Combined with the above code, we can come up with such a relationship: For the sake of “man is the purpose” and that man is in a dominant position in nature, people think that human beings can edit genes to serve human beings out of the need of their own development. But this view may also become relatively cautious, being subject to the ecological security problems that gene editing may bring, the impact on the diversity of gene banks, the impact of feelings that endangering the rights of other organisms and the fear of violating the laws of nature. But synthesizing mood and other factors, worry is actually weak, and the overall attitude is still acceptance. As shown in figure 53.

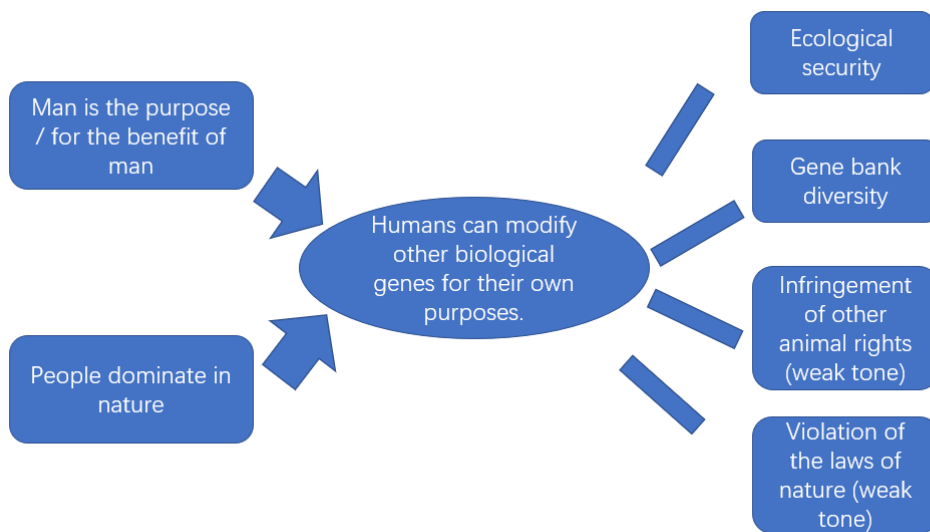


Figure 53 Logic Diagrams of Related Code about Genetic Editing of Other Organisms

2. Gene Editing for Therapy

Based on the interview texts, we analyze the interview data in this field and summarize relevant attitudes as shown in Table 32.

Table 32 Attitudes towards Gene Editing Therapy

Opinion	Descriptions	Examples of interview materials
Support gene therapy	Gene editing is a good thing in the treatment of diseases and should be vigorously developed under the premise of ensuring safety, including editing gene of animals for organ transplantation.	<i>Under safe circumstances, I think I am still willing to receive gene therapy.</i>
		<i>That is, for example, I have cancer, well, if I have this technology, I will certainly support. Right?</i>
		<i>This is acceptable and can be used to treat diseases.</i>
Positive but cautious	Technology may not be perfect now, but technological development and social acceptance always take a process.	<i>There may a technically risk. Moreover, there may be some problems in the social impact. If you really want to let go as completely as plastic surgery, there may be ghosts and snakes. This is not easy to say, but sometimes think about it, this can be seen as a genetic plastic</i>

		<i>surgery. I think if you can accept plastic surgery, you should be able to accept it, which is essentially the same.....However, I think that in the early stage of technological development, it may be similar to the initial acceptance of plastic surgery in society, but slowly we will accept it, and the legal provisions will also be let go. I think this should actually be a similar process.</i>
	Gene therapy can be performed, but make sure it is not inherited	<i>I think we should discuss it separately. If he\she is sure that he will not pass this on to others, I think it is OK. For example, he\she has already had a child and does not intend to regenerate in the future.</i>
High economic cost of treatment	Under the present conditions, gene editing therapy is expensive and unbearable. It's more attractive to people that reduce the cost of treatment.	<i>I think it's a problem of cost. The current gene editing technology can't be universal. It's more likely to be an experimental thing. It might work if one day you let me be a volunteer. But if you want me to pay, I may not be able to pay.</i> <i>I think that it's certainly acceptable if it becomes a universal, social-like project. But if you turn him into an elite medical service similar to going to private hospitals in the United States to treat cancer, it may not be acceptable to most people.</i>

It can be seen that, in general, we support gene editing therapy, just to ensure that the technology is mature, safe, and can effectively control the cost.

3. Views on Gene Editing of Human Embryos and He Jiankui Incident

He Jiankui incident is a hot news in the field of gene editing, and it is also the reason why many people understand gene editing technology. In the interviews, people generally showed a certain degree of attention to this event.

Table 33. Understanding of the event of He Jiankui in the interview

Ah, I heard about this. This matter is wide-spreading, ah, it made a big thing at that time.
The gene editing of the baby, right?
I've seen baby editing events.

The interviewees also showed a complex attitude towards the evaluation of the incident.

Table 34 Views on the He Jiankui Incident

Attitude	Example of interviews
He Jiankui edits the baby's genes to prevent them from developing AIDS, which is acceptable if permitted by law.	<i>But I think this still depends on whether the country has any legal provisions. If this is still not allowed in law, then it should still not be done.</i>

	<i>This is still based on the law.....Well, I think if there is no legal prohibition, if the parents of his (baby) family agree, ah, and if he is not edited, his risk of developing AIDS is very high, then I think it is no problem for him (He Jiankui) to do so. I think that's acceptable.</i>
At present, it may be a little radical, but this is the future direction of human development.	<i>Yes, I think this thing may be too radical now, but I think this is actually the direction of development in the future. This man can't just keep it all the time. According to the present 100-year life span, the body will certainly not be able to do great things. There must be a way to either fly mechanically or join evolution, which may be the only two ways. This is dramatic, but I think this is the case. When the machinery is developing, the human body should be more and more high-end. To realize modernization, add kinds of external machinery, ah, directly to mechanical limbs, or modify human genes, changing some genes that may not be suitable for modern society.</i>
Small-scale scientific experiments can be carried out, but under the supervision of the law.	<i>I think it's acceptable to do scientific experiments within control. But if it is uncontrollable, endangering ethics or social morality, it is not very good. With monitoring and complete legal provisions, it is acceptable.</i>
He Jiankui does not guarantee that gene editing for babies will be able to prevent AIDS, and the risk of technology is high. However, there is a risk of creating Superman, Monster, etc.	<i>I heard that there are a lot of sites HIV attack , so what he (He Jiankui) modified can only protect one of them, and he cannot guarantee that some other things will not go wrong. And because the gene is modified in people, it's a debatable thing.....Well, I don't approve of it. If it goes on like this, it's either Superman or monster. What human beings will become?</i>
It can be used on a small scale.	<i>After editing the child's genes, he/she will have resistance to AIDS. There will be antibodies, he/she will not be infected. It's good for the human body. But if editing on a large scale or changing genes completely, this is still not very good for humans.</i>
Strong opposition, because the technology is not safe, the effectiveness is unknown, and it violates the law.	<i>I think he is experimenting with uncertain technology physically, ignoring the provisions of national law for his own benefit.</i>

From the table, we can see the complex attitude of the public in the face of this event, that is, most of them have expressed some understanding and support for He Jiankui. It is beneficial to the development of babies who may suffer from some congenital diseases to do gene editing, but they also maintain a considerable cautious attitude, worrying about its technical safety and emphasizing the norms of the law and limited scope of application.

The typical attitude of the interviewees is the attitude of the following interviewee:

Table 35 Views of One Interviewee on Gene Editing of Human Embryos

analysis	Interview texts
Babies don't have an independent choice.	<p><i>S: Do you think parents have the right to modify what they consider to be "defective" genes in their children?</i></p> <p><i>I: It depends on what the genes are.</i></p> <p><i>S: For example, if a child has some genes such as congenital diseases, do parents have the right to change these genes when their child is still an embryo?</i></p> <p><i>I: I agree with this. I think it has the right. The simplest example is that abortion is allowed in</i></p>

<p>If we doesn't interfere with the baby's congenital illness, he/she won't be happy when he/she grows up.</p>	<p><i>China, that is to say, the baby is not yet an independent person, but I think it is unacceptable if parents want to make their children look better or smarter. However, if you know that this child is sick, if you do not cure him, he must not grow up, or congenital death. This happens around us, the child had muscle weakness, which is very scary. And after the age of 16, the child will not be able to grow up.</i></p> <p><i>S: Even if he grows up, he may not be happy.</i></p> <p><i>I: He is no longer happy, so I think this genetic modification, ah, should be allowed.</i></p> <p><i>S: But once the technology is open source, it is likely to be difficult to regulate very carefully in the future, and some people may quietly use it as a baby enhancement.</i></p>
<p>There needs to be a law to regulate it.</p>	<p><i>I: So I just said that there must be a legal basis, not casually.</i></p> <p><i>S: Do you think the use of this technology will make humans evolve and make the overall level of human beings stronger?</i></p> <p><i>I: This is hard to say. Because if we don't aim at evolution, we aim at treating diseases, just to treat congenital diseases, such as color weakness and color blindness, I change a gene, and I change his life. The simplest example, like your biology major, it seems that people with color blindness are not admitted. In case there is a child with weak color, he is very interested in biology, through this technology can change his disease, then I think it should still be possible to try.</i></p>
<p>Gene editing is a blessing in the treatment of genetic diseases, but gene editing for the purpose of “enhancement” should not be carried out</p>	<p><i>S: Some people may say that a person with a lower IQ, I can also feel that it is a disease or a defect, so I can make his IQ a little higher.</i></p> <p><i>I: I personally think a little lower IQ is not that serious. It won't too serious an impact on a person. It's not a “defect.”</i></p> <p><i>S: Some people think they don't look good. I'll improve appearance.....</i></p>
<p>Oppose genetic editing for the purpose of increasing IQ and improving appearance</p>	<p><i>I: (interrupting) then I think there is a very problem. This is artificial interference. This is not appropriate. Unless it's a congenital defect, such as the hare lip, which can be modified.</i></p> <p><i>S: But this yardstick is not easy to grasp. What belongs to the category of disease. What is he is not good-looking?</i></p>
<p>People should have a unique life experience</p>	<p><i>I: Foreigners have a point of view, that is, everyone is unique. Right?</i></p> <p><i>S: Yes, there is such a view.</i></p> <p><i>I: For a person, appearance is only a very small part, so many famous scientists, you cannot say how good-looking they are.</i></p>
<p>The boundary between “treatment” and “enhancement” can be defined</p>	<p><i>S: I mean, for appearance, some of us think it a disease, such as the hare lip or the cracked lip. But some of us just think it's simply not good-looking. But sometimes it is difficult to draw a line between the two. Which are diseases and which are simply not good-looking?</i></p> <p><i>I: I think this can be defined.</i></p> <p><i>S: Some people, for example, his forehead is a little too long or his nose is a little crooked, which can be regarded as a disease, or it can be regarded as not looking good. So how to deal with</i></p>

<p>Intelligence, appearance doesn't affect life as badly as disease, they're not vital.</p> <p>The state should define the standard and control the application scope of gene editing.</p>	<p><i>this kind of thing?</i></p> <p><i>I: To tell you the truth, my personal view is that if the hospital thinks that this is a disease, it needs treatment, and it affects his future life and his future development, it is regarded as a disease. If it doesn't affect anything, or if it doesn't have too much impact, I don't think that should be counted. As you just said, IQ is very important. But as a social person, EQ, as well as your social experience, your experience, these are all more important, but you can't achieve it through any genetic editing.</i></p> <p><i>S: That is to say, you feel that in the future, the country should define a criterion to determine which is editable and which is not.</i></p> <p><i>I: Yes. I think gene editing is indeed a boon for some congenital diseases.</i></p>
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Based on the analysis of the overall logic of the interviewee, it can be seen that children don't have independent personality and choice, and that children with congenital diseases will not be happy. Gene editing can bring gospel to these children with genetic diseases. It is acceptable that embryonic gene editing for the purpose of treating genetic diseases is acceptable. But he opposes genetic editing aimed at enhancing intelligence, appearance, etc., which undermines diversity and results in homogenization because everyone's life experience is unique. And intelligence, appearance, and so on do not affect people's lives and development as seriously as some diseases. Draw a logical diagram, as shown in figure 54.

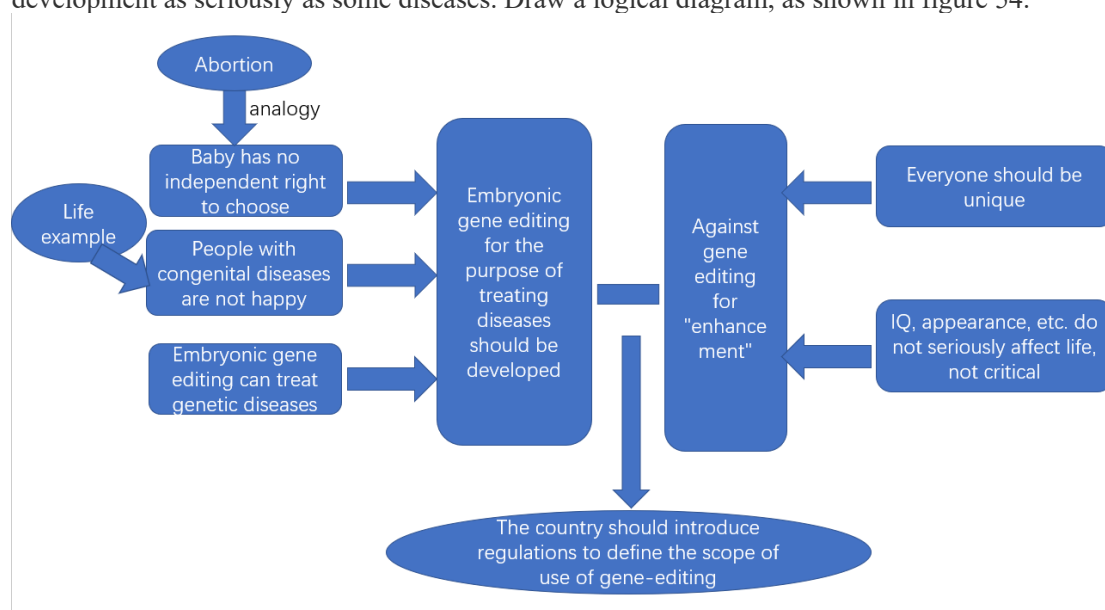


Figure 34 logical map of interviewees' views on embryonic gene editing

Another interesting thing is to compare gene editing with vaccination, cosmetic, and so on in the interview. The interviewees also gave different interpretations.

Table 36 Comparison of Gene Editing and Vaccination

Descriptions	Example of interviews
Gene editing is not as mature as vaccination	<i>I still don't agree with it very much. Although this principle is similar to vaccination, but this technology is not as mature as vaccine technology, right? And it doesn't necessarily work, and the price is bound to be very expensive. And after it does this, it may cause new problems.</i>
Genetic editing, like vaccination, can lead to risks and mistakes. But you can't deny this technology.	<i>There is a problem of closed information. And most of the time, if you can't predict what the impact of a change will be, just say I accept it, But as I said earlier, if it can be promoted to a wide range of social projects, it should be the same as vaccine that children must be given at birth in today's society? I can hear reports of</i>

	<i>vaccine accidents every year, so I assume that one day you force congenital genetic modification, then you can certainly hear the news of the accident. But I still have this point of view that you can't deny this technology because of these potential risks.</i>
Gene editing may have become the only way for society to develop, like vaccination. But it is still hard to accept.	<i>Well, I quite agree with this view, that is to say, this kind of genetic modification may be a necessary way for technology and society in the future. But now I still have a neutral attitude, because I don't know much right now. I may not take the initiative to volunteer to participate.</i>
Not vaccinated may pose a risk to society, but not editing genes.	<i>If you choose not to be vaccinated and others are vaccinated, of course that vaccine may not be effective, but if you do not vaccinate you are at risk of contracting the virus, it will put a lot of pressure on society. But if it just keeps me from cancer, if I choose not to do it, it won't affect anyone else. It is not contagious.</i>

As can be seen from Table 36, most interviewees intuitively believe that embryonic gene editing is not the same as vaccination, but also that gene editing may end up moving from non-acceptance to acceptance like vaccination.

Table 37 Comparison of Gene Editing and Plastic Surgery

keyword	Descriptions	Example of interviews
The essence is the same.	There is no essential difference between gene editing and plastic surgery. Public acceptance requires a process.	<i>In fact, this is the genetic level of plastic surgery. If you can accept plastic surgery, you should be able to accept this thing. They're essentially the same. Plastic surgery can also be very strange, which I was stunned to see. But this is not the reason why we oppose the technology, plastic surgery technology still has its irreplaceable role, for example, sometimes a large area of burning, some people may also be a large area of genetic burning. You cannot give up those who really need it just because some people become ghosts and snakes. It may be similar to plastic surgery. And at the beginning of society, the acceptability of society is not high, but slowly we will accept it and the legal provisions will be let go. I think it should be a similar process.</i>
hereditary effects	Gene editing of embryos may affect offspring, while plastic surgery does not (what about gene editing that does not have a genetic effect? The interviewees did not give a positive response)	<i>I think there is a big difference between them. Plastic surgery does not involve genes, and it is also non-renewable, that is, non-heritable, so beauty changes influence at best a person. Genes may affect the next generation, the spouse, and a lot of things. Because it can be inherited, it must be different.</i>
freedom of choice	The genetic editing of embryos is not voluntary for babies, but plastic surgery is chosen	<i>Yes. Gene editing is not my choice, it is imposed by the will of others. Plastic surgery is mostly</i>

	voluntarily.	<i>voluntary. Although plastic surgery may be affected by peer pressure, social atmosphere, etc., but still make their own final decision.</i>
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According to Table 37, some people think that gene editing is the same as plastic surgery, and the public refuses to accept gene editing technology only out of panic about new things. Others argue that gene editing and plastic surgery cannot be equated from the genetic effect of embryonic gene editing, which is not a voluntary choice made by infants.

4. Future Development of Technology

For gene editing technology, interviewees generally believe that it should continue to develop.

Table 38 Attitude of Interviewees to whether Gene Editing Technology Should Continue to Develop

Public opinion	Interview texts
High and New Technology such as Gene Editing is related to National Security and International Competitiveness	<i>I think these technologies, especially for the developing countries like China, it is impossible not to study them. To be honest, if you don't, the other countries are doing it. From the point of view of national security, ah, I think it is very necessary to continue to study. Even if I set up the law to specify which are available and which are not available; However, this technology must be mastered first.</i>
Technology itself is not right or wrong, depending on how humans use it	<i>In fact, I think that the technology itself is not right or wrong. The criterion of judgment is how to use it. The atomic bomb, used for war, is not right, but it is good to be used in a nuclear power plant.</i>
The problem should be solved slowly. We can't stop developing technology just because there's a problem.	<i>I1 : Now some people study the relationship between human cloning. There is a game called Detroit to become human. There may be problems in the future, such as whether they are the same species as us in the event of genetic editing of people in the future, which may be a question. But I think we should actually let it go. I2: The problem will appear slowly and be solved slowly. It is all the problem of the second generation. I1 : That's not why people like us are worried about this technology. If you're worried about robots, you don't develop robots.? I2 : Worry about artificial intelligence and don't develop artificial intelligence? I1 : Isn't that half of the college students in China unemployed on the spot?</i>
In the process of development, we should strengthen supervision and ensure safety.	<i>There must be regulations to restrain them. Ethics must be balanced by the legal system and morality, and there must be security when there is ethics. It is very beneficial to human beings to solve the problem of security on the basis of first, and then to standardize ethics.</i>

V. Philosophical Discussion and Regulatory

Analysis of Gene Editing

Empirical studies such as questionnaires and in-depth interviews provide us with direct information on the public's perception and acceptance of gene editing techniques, as well as the public's complex attitude toward this immature new technology. This level of research addresses the question of what the public attitude is. But the more important question is, how should we rationally view gene editing technology? Should we continue to develop gene editing technology? How should we develop and use gene editing techniques? These problems have been deepened to the level of “normative science”. Research in the field of science and technology or investigation at the empirical level is not enough. For this reason, we have discussed the gene editing from the philosophical level and investigated the current corresponding laws and regulations of the country.

1. Philosophical discussion on gene editing

In fact, since the advent of gene editing technology, philosophical and ethical debates about it have never stopped. Is gene editing technology a violation of natural laws? Is human being playing the role of God? Do humans have the right to transform the genes of other organisms? Will changing genes bring many consequences that we can't imagine? When human genes can be artificially transformed, how should we treat people's values and dignity?

(1) Literature research

In 2015, when CRISPR technology has just become popular, Science and Nature's subsidiary Nature Biotechnology has published articles on the ethical issues of gene editing. The article on Science Impurity, with the title “A prudent path forward for genomic engineering and germline gene modification”, puts forward four points, namely:

1. Strongly opposed gene editing for human germ cells;
2. Call for the creation of a public forum to give scientists and ethicists a platform to popularize the knowledge, potential benefits and risks of gene editing to the general public;
3. Encourage and support open and transparent research for gene therapy to prepare for subsequent assessment of clinical safety;
4. Organize global forums including researchers, legal scholars, ethicists, government officials, interest groups and the public to further discuss ethical and social issues related to gene editing, and provide reference for government decision-making.

Nature Biotechnology's article “CRISPR germline engineering—the community speaks” has contacted 26 researchers, ethicists and business leaders around the world to discuss 10 hot topics related to gene editing technology. These topics include:

Q1 From the current development rate of gene editing technology, in vitro artificial insemination (IVF) and reproductive stem cell research, how much do you think gene engineering of germ cells is inevitable?

Q2 The method of transforming germ cells is applied to the clinic. What are the outstanding technical obstacles?

Q3 What are the risks and potential benefits of germ cell gene engineering for personal health?

Q4 What are the social risks and potential benefits of germ cell gene engineering?

Q5 Under what circumstances can human germ cells be accepted at an ethical level?

Q6 Do you think the best way to supervise is to ban internationally, issue temporary injunctions, regulate regulations, or let go?

Q7 Whether it is possible to achieve a similar situation around the internationalization of CRISPR germ cell

transformation, related research, the ease of use of the technology, and the rise of “garage biology” outside the traditional research center. The solution like the ASILOMAR AI PRINCIPLES?

Q8 CRISPR technology is easy to use and is used worldwide by various laboratories. Does this affect the effectiveness of the ban or suspension order? Compared with the issue of reproductive gene therapy and reproductive cloning, will this situation of CRISPR bring more problems?

Q9 Britain has approved mitochondrial replacement therapy, and recently there have been reports of implanting human somatic cells into non-nuclear oocytes. What is the difference in ethical challenges caused by CRISPR germ cell engineering?

Q10 Do you need international or domestic surveillance for such research, or a combination of the two? Which party do you think is the appropriate regulatory or government agency to regulate such research?

People from 26 different fields have different views on these issues, but they all think that they need to be cautious about gene editing technology.

In China, ethical discussions on gene editing technology are also underway. Especially after the “He Jiankui Incident” last year, this issue has attracted more people's attention. Professor Qiu Renzong of Peking University is one of the earliest scholars to study bioethics in China. He has also paid close attention to this field in recent years and has repeatedly published articles on relevant ethical issues. Professor Qiu Renzong mentioned two different treatment attitudes toward emerging technologies, the “proactionary approach” and the “precautionary approach”: the former believes that since the technology appeared, it should be developed. The technology was developed vigorously before there was no evidence that the risk of the action was greater than the benefit. If you are afraid of trying new things, human civilization cannot make progress. The latter believes that when there is a lack of understanding of a thing, we must not act rashly, because we do not know how serious consequences may be behind the technology.

(2) Communicate with humanities

After reading the relevant literature, we also visited several teachers from the Department of Philosophy and the Institute of Scientific History and Science and Culture of Shanghai Jiao Tong University to communicate with them and understand their views and analysis on gene editing.

In the communications, Associate Professor Wang Qiu does not agree with some people's attitude that the gene editing violates the laws of nature, is the view that human beings play the role of God, and cannot oppose gene editing for reasons such as “unnatural”:

Wang: There are still some people who think that human beings are too arrogant. Although this is not a theological point of view, it is a fear of life, which can be called “quasi-theology.” Although they do not believe in the existence of a supreme God, for there is no creator like God, but they think that the whole universe has its laws, life is worthy of awe, you can not intervene, a bit of the deism of nature. In fact, this kind of thinking like Taoism in China also has a little sence of deism. “Tao is natural.” Therefore, as a creature, we cannot interfere with the operation of this heaven. This argument highlights a conflict between “the heavens” and “humanity.”

Sun: But I find it difficult to distinguish what is “the heaven” and what is “humanity”, what is “natural” and what is “unnatural”. In many cases, “god” and “people” are mixed.

Wang: Yes, I have considered this issue. I think this view is a bit untenable. In the case of our human beings using fire, in fact, the initial fire is a natural phenomenon. It should not be controlled by human beings as it is now. Anyone who takes a lighter can catch fire. Like the story of Prometheus in Greek mythology, we humans are “stolen fires”, and then there is fire, which changes our diet and actually changes our genes. So this change started very early. In fact, it is not “natural” that human beings originally retained the fire. So this reason is not true.

In addition to the gene editing of human embryos, he is generally accepted for other gene editing, because mutations and metastasis of genes are constantly occurring in nature. He says:

Wang: As far as I am concerned, even these crops and the gene editing of these staple foods are acceptable. Because of the evolution of organisms, these genes are constantly changing, only that the variation of these natural worlds occurs slowly. This gene editing is not a human intervention. The reason why we are afraid or rejected by gene editing is mainly because we have never encountered such a problem. To put it simply, in addition to the gene editing of the embryo, like He Jiankui's approach, creating a complete person to let him grow, may have many unpredictable consequences, I think other can edit. For example, stem cell gene editing, to cultivate a new organ for transplantation, I think this is ok.

Our fear of gene editing comes from what we have never seen before. This is an instinctual fear of new things. In the communication, we reviewed the changes in the acceptance of left-handers, homosexuals, vaccinations, organ transplants, etc. in history, and talked about the plasticity of human morality in the face of new things. But he believes that gene edited babies, unlike the above, will always be an intuitively unacceptable thing. Because human being is always unique in moral judgment, he is different from other creatures.

Sun: Actually, I think that in the early days of organ transplantation technology, the first people who receive organ transplants will be treated as heterogeneous. Including the first one or two test-tube babies, they will face the same dilemma when they enter the society. However, after the technology is mature and large-scale promotion, there is no such problem. Is the gene edited baby the same?

Wang: Well, there is a problem involved. The key to this question is how strong our intuitive plasticity is. Our intuition for some problems is more plastic. For example, regarding the left-handed question, in Europe, right is the meaning of the right hand, and it also means correct. So in the Middle Ages of Europe, a left-hander was considered to be wrong and was to be forcibly corrected. But today, who of us will discriminate against left-handers? Even we will think that he is very talented that his right brain must be very developed. In the setting of some tools, we will also give left-handed some humanized measures. So in this case, our intuitive plasticity is very strong. For the problem of homosexuality, our intuitional plasticity may not be as strong, but at least in places like California, we are already accepting homosexuality; on the mainland, we do not seem to have. This is because of our acceptance of it, that is, the plasticity of intuition. Like an organ transplant, I have the same appearance as you. Even if you have a transplanted organ, you can't see it, and it's nothing remarkable. But if I say that I am a gene edited man with IQ over two hundred, and you are just a natural person with IQ of only one hundred and three, how can you compare with me, but also very inferior, you would think why THEY are better than me. Until one day, you suddenly discovered that he was a gene edited person. You have always been better than him because his intellectual genes have been strengthened. Then you will conclude that he was cheated. But the problem is that this kind of cheating has not been approved by him, only his parents have edited him. There is also a "right to choose". I did not agree, you will give me gene editing, and in the future, I will not know what kind of encounters and opinions I will encounter.

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Wang: ...Because each of us is a subject, let us change our minds. If we edit ourselves or edit our own children, many people will not speak. Editing our own human genes is completely different from editing the genes of any other creature. Microbial gene editing, plant gene editing, general mammalian gene editing, it seems to be a continuum, can be roughly analogized; but as soon as human gene editing, it seems that there is a gap, we have no intuition The law crossed this gap. For some intuitions, reasons, and cases of other biological gene editing, there is no way to directly copy to human's own gene editing.

Associate Professor Wang Qiu opposed the human embryonic gene editing, but he did not approve of the objection of "parents invading the child's autonomy." He believes that freedom, choice, etc. all have certain social and historical conditions, not absolute. For example, he said that educating two-year-old children not to play with knives, etc. is actually a necessary "autocracy". The two-year-old child does not have mature rationality and cannot judge right or wrong. In fact, there is no choice. Not to mention the baby.

Sun: Regarding the right to freedom, some people think that life is not free. The birth of a person is not determined by oneself. In this way, parents have the right to give birth to children, and they also have the right to edit their genes.

Wang: I used to have a sister mentor who said to her ex-husband that she wouldn't want children in the future. Because she felt that she would give birth to him without his consent. It's unfair. But we will feel that only rational people can have the right to consent. So what is the rationality of an embryo? Even said that one of my children is now two years old. I have to show some "autocracy" in some places, such as telling him not to tamper with the knife in the kitchen, not to play by the river. At this time, those liberals cannot criticize my "autocracy." Because a two-year-old child has no rational choice ability at all, he is not good at what is good and has no clear judgment. Pushing back, the two-year-old child has no complete choice, let alone an embryo? At this time, some kind of "authoritarianism" is necessary. But the problem is, if you intervene too much with him, then society will look at him with some kind of vision, and he will say that he is not a natural person, but a person who has been edited. This is a hurt after he enters society. Therefore, in this sense, parents can not do gene editing on him.

He believes that the best objection is the security of the gene editing technology itself. He believes that our understanding of living organisms is still limited. We don't know how much impact it will have on the whole system after taming a particular gene. Especially when this kind of transformation has gene effects, it should be more cautious.

Wang: ...we don't know much about the huge gene pool of human beings. Will there be any other influences in the modification of several places? If the genes change, will it have some influence on other places? We all do not know. This project is too big, just like you build a house, we have to calculate how each structure is mechanically set. For the human body, we still know too little about it. If the next conclusion is even used to edit a new person, then I don't support it from the perspective of technical security.

He further mentioned that technology is not “neutral”. With the rapid development of modern science and technology, the power of technology is so powerful that it is hard to imagine. We have no ability to try and try again. Because once the mistake is made, the consequences may be unaffordable for all human beings.

Wang: ... We used to think that science and technology is a tool. Good people can use it. The bad guys can also use it. It is neutral. It has no value bias. But in fact, in the past 50 years, many humanistic thinkers have felt that technology has its own nature. For example, I built an atomic bomb. Is it neutral? Is it a toolbox? Can't say that. Because it is always a threat because it is placed there. Like a nuclear bomb, or the biotechnology of this gene editing, if it goes wrong, it does not affect a small group of people. The technology of the past is only a small scope. This technology has been mistaken. For example, if the bridge is not built well, it may affect the villagers in the village to cross the river. However, if there is a problem with modern technology, its harm may be global. If we are eager to do it while the technology is not fully mature, it may cause loss of control. This kind of loss of control is not to say that the technology is in the hands of He Jiankui or Li Jiankui, but the technology itself is divided.

See the appendix for details of the communication.

Unlike Wang Qiu, who pays more attention to technical safety, Associate Professor Fan Muyu values the ethical and social issues behind him. She believes that gene editing of people is first and foremost a standard for human beings: what is the “excellent” gene and what is the “inferior” gene, so there is a danger of slipping into racism and the Nazis.

Fan: ... First of all, gene editing is actually setting a standard subjectively, that is, it is artificially judged whether it is good or bad. Or we have no absolute “excellent” or “inferior” genes from a philosophical or ethical perspective. For example, in the experiment of He Jiankui, he cut off the genes that are said to cause AIDS. Of course, many people think that this gene is really bad. They will feel that many of the disease-causing genes are bad. They all go to the editors. If you develop this way, mentally deficient and congenital heart disease will be considered as “Not good”, if I go to extremes, I feel terrible. Just like the Nazis, what kind of people we choose to choose the best gene is to artificially judge the pros and cons. Some people will say that I only want good genes, and then it is possible to develop into racism. For example, racists may think that blond is a good gene, and it will be a good gene for white skin. For example, homosexuality is now removed from the mental illness list, but there are still many people who do not accept homosexuality. They think that homosexuality is a disease. Isn't this gene we should edit it? This is what I think is ridiculous. What criteria do we use to judge the pros and cons of genes? Why do we think that our standards are right and good? What kind of genes must be good and must be bad? In fact, there is no absolute standard. So I am against gene editing.

She believes that each of us has a unique life experience and should not have standardized genes like industrial products. The world should be diverse.

Fan: In fact, many philosophical psychology theories tell us that each person's life experience is unique and belongs to him. There are of course some good experiences, and some are not good, but they are all inseparable parts of life experience.

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Fan: Just like when there was a cloned sheep, there will be people worried about whether there will be clones. It should be said that this technology can be achieved, but it will not develop the technology of copying people. We are worried about some advanced artificial intelligence. That is to say, this technology must be used with caution. It is a bit of a feeling of opening Pandora's box. You don't know the consequences that he may cause. Many times, everyone is coming from a good side. For example, if you can copy a person, I will come. I'm sick, I can use his organs, but you can't get from the technical image, he may cause ethical problems and legal problems, and let him have no consciousness, even if he keeps lying in the incubator, it is inhuman. Let him be conscious, especially if he is the same person as you, then your relationship with him, gene editing is also, and finally it may be similar to this, gene editing becomes another person, only used for basic Later, it may be used to edit physical fitness, edit IQ, and even remember, but is this person still the original person?

For the gene editing of other organisms, Professor Fan Muyu believes that it cannot be generalized. Gene

editing of lower organisms may not be a big problem, but for higher animals that are closer to people, they also have feelings and nervous systems, and people may have feelings, and they should be treated with caution.

Fan: Well, I think there is no problem with plants and single-cell microbes. It may be because there is no feeling, but if it is a small animal, a cat or a dog, it may be because people have feelings for it, so they don't want him completely. They are instrumentalized. Although we often use them as tools and sometimes eat their meat, it is like some environmental organizations. Even cosmetics experiments are not allowed on animals. Of course, not everyone can be asked. I did this, so I said that I have reservations and I am not totally opposed. But if it is a small animal, I am still worried and causing harm. I think that sometimes people may become the most powerful living creatures. People are very arrogant at times, and they feel that they can be used for me. But from the perspective of Buddhism, all life should be treated equally, just as we did not consider them before killing pigs and slaughtering sheep. Feeling, but now in some countries in Germany are electric shocks to kill them, just like euthanasia, reducing their suffering, especially mammals, is intellectual, he has feelings, also feels painful, so I think I'm not entirely sure.

Talking about the relationship between human and nature under gene editing technology, especially the relationship between human development and nature protection, she believes that we can't be as extreme as some environmentalists, but we must also strive to balance and protect in the process of development. Good ecological environment.

Sun: Like a little environmentalist, it is not in a religious perspective. It is not the right way to transform nature. I feel that people should obey the laws of nature.

Fan: It is true that these years have this tendency, including the government. If you want to transform the environment and transform the earth, it will be greatly damaged. So some people will be more radical, that is, don't change. He is more harmonious. Including human destruction of nature and destruction of the biological environment, this species has been decreasing. If only human beings, each species lives on the earth, I think it can be understood from this angle, but it cannot be said. So radical, but how can we minimize the damage to him during the development process, or find a way of harmonious symbiosis, not to say that people can dominate, people can rule, I think this is better.

Sun: I used to see an argument that people should conform to nature and clarify what is natural. If you feel that you know a part of nature, then people do it naturally. If you think that people are not natural, then people Everything you do is unnatural.

Fan: I feel that this is a bit of a sophistry. People are naturally part of nature. Naturally speaking, it is a lifeless one. It is a generalization, mainly an environment, but why people turn naturally against it because many times People are naturally out of a state of opposition, but people should indeed be part of nature.

She also started from her own research background. From the Indian and Buddhist philosophy, in order to develop the ethical issues of biotechnology and deal with the relationship between man and nature in the current rapid development of science and technology.

Fan: We originally had a professor in the German burger, who was doing Buddhism. He had been writing books since he retired. He was also influenced by Buddhist thoughts. He became a staunch environmentalist and did not even fly. The plane destroys the environment. When it comes to it, it is by train. His book is about Buddhism and nature. The Buddha is talking about the life of the people. You don't know what the next life will become, and even reincarnate to the animal. Of course, you hope to suffer less pain, so it is said that the Buddha's life is in the same place, including the fact that you see this little flying insect. It may be your parents' friends and relatives in the past life, so he will have this life and life. They are all equal, and there are many such things in Buddhism, depicting the ideal world, what is the pure land, just like the tropical rain forest of India, there will be lush vegetation, blooming flowers, birds and songs. In Indian philosophy, it is very similar to this. He has a lot of ways to integrate people with the outside world, the outer hidden highest, he What practitioners like Yulin and very flat, he also feels that this principle can only be realized in nature. Indian philosophy is also adult reincarnation, and it is the same as Buddhism. As long as it involves this reincarnation, it will involve An attitude of her creature is equal to nature and to other creatures.

In the end, she pointed out that the work of science in science popularization is still far from enough, leading to the disconnection between scientific research and the public, making the public more vulnerable to the influence of some media, lacking professional information, and misunderstanding and prejudice against cutting-edge technology.

Fan: I think that on the one hand, it is the influence of the media. On the other hand, the public is more interested in this kind of publicity and the stars like Xiao Cui, and they are more willing to believe them,

although they may not have this professional credibility, instead I am willing to believe the opinions of experts and feel that experts are kidnapped by interests. Finally, the media public is a means to understand the mass media very well, and many of them are only reasonable, do not understand the laws of the mass media, and do not use popular universality. The way to promote, of course, this is also related to the media, and finally did not get good publicity. So this propaganda is very difficult to do. I can understand that just like we sometimes have to talk about a very academic thing, there may not be many people who are willing to listen, but if you tell some legendary stories, you are very willing to listen. This is also very helpless. Very academic things, we must make this kind of propaganda, but not like this, there is no audience and attention. After all, you can't expect the scientific literacy of ordinary people, many of them have not received higher education, and may be more willing to accept the media. Some may be sensational, and many people will take the opportunity to engage in some nationalism. How do Americans do it, dump it into the country, and catch such a banner, it will be very sensitive.

See the appendix for details of the communication.

(3) Summary

On the basis of literature reading and teacher communication, the main controversies related to gene editing are as follows. Some of them involve gene editing of other organisms, while others are gene editing directly targeting the human body. It includes whether the technology that the consequentialist values are favorable, whether it is “good”, and whether the technology that the obligation theorists value is justified, whether it is “right”; both biologically, There is also an ethical social argument.

- Technology development?

Proponents of gene editing believe that any technology needs a process from immature to mature. The history of science is the history of trial and error. The development of technology always requires experimental products. It is impossible to hinder the opportunities of technological development because of ethical disputes.

Opponents of gene editing believe that gene editing technology is not yet mature, and security is difficult to guarantee, especially the existence of off-target problems. Moreover, modern technology has developed so rapidly that its power is so great that we cannot afford the cost of “trial and error.” We can't try things like hydrogen bombs, so we must be cautious at the beginning of technology development.

- Public acceptance?

Proponents of gene editing believe that any new thing is accepted by the public and requires a process. Historically, vaccination, organ transplantation, and test tube babies have been controversial at the beginning.

Opponents of gene editing believe that gene editing technology is different from the above-mentioned technologies. It directly modifies the gene material of living things, has high risk, is irreversible, and involves the violation of the basic dignity of life. It is impossible to accept the “bottom line.”

- Human's arrogance?

Proponents of gene editing believe that, as the scorpion said, “Is it useful to use it for the sake of heaven and earth?” Humans edit genes for other organisms, just like gene engineered bacteria, bioreactors, etc. Serving human production and life is beneficial to human development.

Opponents of gene editing believe that life is a very complex system, and human cognition of life is still very limited. Even the genome of *E. coli* cannot be said to be fully understood. In this case, it is a manic act to start artificially transforming genes by relying on “incomplete information.” They quoted the ancient story of *Oedipus the King*. Oedipus knows the fate of his “killing father and mother”, but he does not know who his own parents are. Under the influence of this “incomplete information”, he fled the foster parents' home and thought he had escaped his fate, but he was getting closer to the end of his life. They use the metaphor of *Oedipus the King* to explain that people making arrogant decisions under “incomplete information” often fall into dangerous situations and edit with such genes.

- Natural laws?

Opponents of gene editing believe that gene editing is a human life system that artificially intervenes in nature. It is the gene material that artificially transforms organisms. It is the role of human beings as “God” and is a violation of natural laws.

Proponents of gene editing believe that mutations and metastasis of genes are constantly occurring in nature. Man himself is also a part of nature, and it is also a factor of nature. Man and nature cannot be separated. There is no such thing as “the heavens” and “humanity”. There is no such thing as “violation of the laws of nature.”

- Ecological security?
Opponents of gene editing believe that gene editing of other organisms has the potential to increase mutations and gene transfer, resulting in ecological risks. And once it is used by terrorists to transform biological weapons such as “superbugs”, the consequences are unimaginable.
Proponents of gene editing believe that human mutations and metastasis are already occurring in nature, and human beings are also a natural factor. This ecological risk is preventable and controllable. As for the use of terrorists, the mistake is not in the technology itself. What is needed is that we strengthen supervision rather than restrict technological development.
- The rights of other creatures?
Opponents of gene editing believe that “all life are equal”, people have no subject-to-object rights to other creatures, and humans' transformation of other organisms' genes violates the rights and dignity of other creatures.
Proponents of gene editing believe that “people are the purpose” and “people are the yardstick of everything”, and talent should be the starting point and the foothold for all considerations. Lion hunting cows is not a violation of goat rights. Goats escaping from lions are not violations of lion rights. This is the natural law. As long as gene editing can be beneficial to people, it is justified and acceptable.
- Is the technology neutral?
Proponents of gene editing believe that technology itself is neutral, and the outcome depends on the people using the technology. Gene editing technology itself does not matter right or wrong, as long as the right place is used, it can benefit mankind.
Opponents of gene editing believe that technology itself is not neutral. The knife has the purpose of “cutting”. The atomic bomb is enormously devastating, and the technology has its own internal logic. Gene editing technology itself is dangerous. Without He Jiankui, Li Jiankui will appear. Monsters like “Frankenstein”, their creators themselves will lose control.
- “proactionary approach” and “precautionary approach”
Proponents of gene editing believe that people are free and should not be constrained by necessity. Since a person has this technology, when it is impossible to prove that its risk is greater than the income, it should be “no guilty assumption”, use it, and practice it.
Opponents of gene editing believe that high-tech, such as gene editing, has great risks and uncertainties. If it cannot prove that the benefits outweigh the risks, it should be “guilty assumption” and prepare for the worst possibility. It should be careful and avoid risks.
- The means of evolution?
Proponents of gene editing believe that gene modification can selectively remove some unfavorable disease-causing genes, which is a means of human evolution. They believe that human beings are also part of nature and a choice of natural choices. People's choices of themselves are essentially part of natural selection.
Opponents of gene editing believe that, first, the evolution of gene editing is actually the so-called “pros and cons” of artificially determining genes, which is risky to racism and Nazi; second, our understanding of gene banks is still very limited, some superficial genes may not be of use to humans, and the transformation will have serious consequences. Third, each person's life experience should be unique. The so-called gene editing makes human evolution a factory. Like the standardized products produced, it is the “homogeneity” of human beings and the loss of diversity.
- The tooling of human?
Opponents of gene editing believe that human-oriented gene editing is the alienation of human beings, the “tooling” of people, and the violation of human dignity.
Proponents of gene editing believe that it is the “tooling” of human beings in the modern division of labor. By enriching human capabilities, gene editing technology can help people achieve “free and comprehensive development”, which can get rid of the tooling of human beings.
- Social pressure?
Opponents of gene editing believe that people who are not ready to accept gene editing may face a range of discrimination and social problems.
Proponents of gene editing believe that it is precisely the opponents of gene editing that have created this discrimination. In the past, left-handers, homosexuals, organ transplanters, and test-tube babies have also suffered from public discrimination. However, when society generally accepts this phenomenon, such discrimination will cease to exist. Left-handers, homosexuals, organ transplanters, and test-tube babies are also ordinary people and no different.
- The right to choose?
Opponents of gene editing believe that gene editing of embryos violates the autonomy of embryos and is a violation of freedom.
Proponents of gene editing believe that freedom is relative, and that people are always subject to the times and society. Everyone does not choose to be born into the world, nor has the right to choose their own family. Life is not free. When educating a two-year-old child not to play with knives, a two-year-

old child is irrational and has no autonomy. He must accept this teaching, not to mention a newborn baby.

- Intensify inequality?

Opponents of gene editing believe that gene editing can exacerbate inequality. The rich have better resources, will transform their children stronger, and the poor are more socially disadvantaged.

Proponents of gene editing believe that social inequality itself exists, and even without gene editing techniques, rich children have better resources. To solve the problem of inequality depends on other efforts, and we cannot blame the generation of inequality on the gene editor.

The ethical and philosophical issues of gene editing are complex, and the arguments of supporters, opponents, and some supporters and some opponents will continue. Especially the human-related gene editing technology faces ethical and philosophical controversy. The gene editing is bigger and more intense. According to the survey data, most people have a moderate degree of acceptance of gene editing, and they have a high degree of acceptance of non-human, safe, and less risky genes. For foods, this can be indirectly applied to humans and directly to human embryos. The gene editing of the subject is very low. For the time being, this debate will continue for a long time.

2. Existing laws and regulations on gene editing in China

Since gene editing technology has only begun to receive widespread attention in recent years, its legislative research has lagged behind. There are no laws and regulations specifically for gene editing in China, but there are several specifications related to gene editing technology.

The Biotechnology Research and Development Safety Management Measures is a general document and a general specification for all biotechnology-related research and applications, which states:

Article 3 If engaged in biotechnology research and development activities, it shall abide by laws and administrative regulations, respect social ethics, and shall not damage national security, public interests and the legitimate rights and interests of others, and shall not violate the relevant international obligations and commitments of the People's Republic of China.

It is clearly stated that when conducting biotechnology research and development, it is necessary to take care of laws and regulations, social ethics, national security, public and other interests.

The latter one further stipulates:

Article 4 The safety management of biotechnology research and development shall be managed hierarchically. According to the degree of potential risk of biotechnology research and development activities, it is divided into high risk level, higher risk level and general risk level. High-risk level refers to the degree of potential risk of biotechnology research and development activities that can cause very serious or serious diseases in humans or animals, or cause serious harm to important agricultural and forestry crops, Chinese herbal medicines and the environment.

The high risk level refers to the degree of potential risk of biotechnology research and development activities that can cause serious diseases in humans or animals, or cause serious harm to important agricultural and forestry crops, Chinese herbal medicines and the environment.

The medium risk level refers to the degree of potential risk of biotechnology research and development activities that can cause human or animal diseases, but generally do not pose serious harm to humans, animals, important agricultural and forestry crops, Chinese herbal medicines or the environment.

The general risk level refers to the degree of potential risk of biotechnology research and development activities that normally do not pose a hazard to humans, animals, important agricultural and forestry crops, Chinese herbal medicines or the environment.

In the appendix to the regulations, the division of the three risk levels is further defined:

High risk level

1. In the "List of Pathogenic Microorganisms Infected by Humans", research and development activities involving the first and second types of pathogenic microorganisms must be carried out in biosafety level 4 or tertiary laboratories as required;

2. In the "Catalogue of Classification of Animal Pathogenic Microorganisms", research and development activities involving the first and second types of pathogenic microorganisms, must carry out research and development activities in biosafety level 4 or tertiary laboratories as required;

3. In the “Inventory of Entering Animal Epidemic Diseases of the People's Republic of China”, research and development activities involving the first type of infectious diseases and parasitic diseases;
4. In the “The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on the Destruction of Such Weapons”, research and development activities involving applicable biological warfare agents, pathogenic microorganisms or toxins;
5. Research and development activities involving newly developed highly pathogenetic pathogenic microorganisms;
6. Synthetic activities involving various types of microorganisms with infectious activity;
7. Research and development activities involving genetic engineering such as human genetic editing with significant risks;
8. Other biotechnology research and development activities with the same potential risk level.

Medium risk level

1. In the “List of Pathogenic Microorganisms Infected by Humans”, research and development activities involving third-class pathogenic microorganisms and in accordance with regulations must be carried out in the Biosafety Secondary Laboratory;
2. In the “Catalogue of Animal Pathogenic Microorganisms”, research and development activities involving the third type of pathogenic microorganisms must be carried out in the Biosafety Secondary Laboratory in accordance with regulations;
3. In the “Inventory of Entering Animal Epidemic Diseases of the People's Republic of China”, research and development activities involving the second category of infectious diseases and parasitic diseases;
4. Research and development activities involving genetic engineering with greater risks such as human gene editing;
5. Other biotechnology research and development activities with the same potential risk level.

General risk level

1. In the “List of Pathogenic Microorganisms Infected by Humans”, research and development activities involving the fourth type of pathogenic microorganisms must be carried out in the Biosafety Level 1 laboratory in accordance with the regulations;
2. In the “Catalogue of Classification of Animal Pathogenic Microorganisms”, research and development activities involving the fourth type of pathogenic microorganisms must be carried out in the Biosafety Level 1 laboratory according to regulations;
3. Research and development activities involving other infectious diseases and parasitic diseases in the “Catalogue of Animal Quarantine Diseases of the People's Republic of China”;
4. Research and development activities involving genetic engineering with general risks such as human gene editing;
5. Other biotechnology research and development activities with the same potential risk level

Among them, the seventh category of high risk, the fourth category of higher risk, and the fourth category of general risk all explicitly mention human gene editing. However, gene editing of other organisms has not been explicitly proposed, but according to the danger of editing objects, it can also be classified according to the above criteria.

The “Technical Application Management Method for Medical Technology (2018 Edition)” is closely related to gene therapy. Which states:

Article 9 Medical technology is prohibited from being applied to clinical (hereinafter referred to as prohibited technology) if it has one of the following conditions:

- (1) The safety and effectiveness of clinical application are not clear;
- (2) There are major ethical issues;
- (3) The technology has been clinically eliminated;
- (4) New medical technologies that have not been clinically demonstrated.

The catalogue of prohibited technical categories shall be issued by the National Health and Health Commission or entrusted by professional organizations to make and publish, and shall be adjusted as appropriate according to the situation.

Article 10 Any medical treatment technology (hereinafter referred to as restricted technology) that requires a focus on strengthening management, other than the category of prohibited technology, shall be strictly managed by the health administrative department at or above the provincial level:

- (1) It is technically difficult and has high risks. It has high professional requirements for the service capabilities and personnel levels of medical institutions, and it is necessary to set qualified conditions;
- (2) Need to consume scarce resources;
- (3) Involving significant ethical risks;
- (4) There are irrational clinical applications that require key management.

The National Restricted Technology Catalogue and its clinical application management norms are formulated or issued by the National Health and Health Commission or commissioned by professional

organizations to make and publish, and adjusted according to the actual situation of clinical application. The provincial health administrative department may, in combination with the actual situation of the administrative region, supplement the projects related to the provincial restricted technology on the basis of the national restricted technology catalogue, formulate and release the management norms for the clinical application of relevant technologies, and report them to the national health and health commission for the record.

Gene editing and treatment technology clearly meets the requirements of “high difficulty, high risk” and “involving major ethical risks”, and its clinical development should be carefully and carefully controlled. Another important regulation, the Ethical Review of Biomedical Research involving People, states:

Article 7 *Medical and health institutions engaged in biomedical research involving human beings are the subject of management responsibility for human biomedical research ethics review work. Ethical committees shall be established and effective measures shall be taken to ensure that the ethics committee conducts ethical review independently.*

If the medical and health institutions do not have an ethics committee, they shall not carry out biomedical research work involving people.

Article 8 *The ethics committee's duties are to protect the legitimate rights and interests of the subjects, to maintain the dignity of the subjects, to promote the development of biomedical research norms; to conduct an ethical review of the biomedical research projects involving humans, including initial review, follow-up review and review. Etc.; organize relevant ethics review training in this institution.*

It is emphasized that biomedical research for humans needs to be cautious and careful. An ethical committee must be established to conduct strict ethical review to fully protect the legitimate rights and interests of the subjects and maintain their dignity. This is a basic requirement for all biomedical research involving people. The regulations also clearly stipulate the ethics committee's personnel composition, production methods, tenure, project declaration, audit process and standards, filing, and supervision.

The six basic principles that must be adhered to in biomedical research involving people are also proposed in the regulations:

Article 18 *Biomedical research involving persons shall meet the following ethical principles:*

(1) The principle of informed consent. Respect and guarantee the subject's discretion to participate in the study, strictly implement the informed consent procedure, prevent the use of deception, inducement, coercion and other means to allow the subject to participate in the study, allowing the subject to withdraw from the study unconditionally at any stage;

(2) The principle of controlling risks. First, the subject's personal safety and health rights are prioritized, followed by scientific and social interests. The research risk and benefit ratio should be reasonable, and strive to make the subjects avoid harm as much as possible;

(3) The principle of free and compensation. Subjects should be selected fairly and reasonably. No fees should be charged for participants to participate in the study. Appropriate compensation should be given for the reasonable expenses incurred by the subjects during the course of the test;

(4) The principle of protecting privacy. Effectively protect the privacy of the subject, truthfully inform the subject of the storage, use and confidentiality measures of the subject's personal information, and not disclose the personal information of the subject to a third party without authorization;

(5) The principle of compensation according to law. When the subject participates in the study and is harmed, he/she shall receive timely and free treatment, and shall be compensated according to laws and regulations and the agreement of both parties;

(6) The principle of special protection. Subjects of special populations such as children, pregnant women, mentally retarded people, and people with mental disorders should be specially protected.

For the “informed consent principle”, the regulations have further refined the rules, and the details of the content, methods, and conditions for exempting informed consent have been carefully defined.

The Ethical Guiding Principles for Human Embryonic Stem Cell Research specifically regulates the study of human embryonic stem cells, especially the source of stem cells. The guiding principles indicate:

Article 5 *Human embryonic stem cells used for research can only be obtained by the following methods:*

- 1) Excess gametes or blastocysts during in vitro fertilization;*
- 2) Naturally or voluntarily selecting aborted fetal cells;*
- 3) The cells of blastula and parthenogenetic blastocysts obtained by somatic cell nuclear transfer technology;*
- 4) Voluntary donation of germ cells.*

Article 6 *To conduct human embryonic stem cell research, the following code of conduct must be observed:*

- 1) *The blastocyst obtained by in vitro fertilization, somatic cell nuclear transfer, parthenogenesis or genetic modification shall not be cultured for more than 14 days from the time of fertilization or nuclear transfer.*
- 2) *Human blastocysts obtained in the preceding paragraph shall not be implanted into the reproductive system of humans or any other animal.*
- 3) *Human germ cells must not be combined with germ cells of other species.*

Article 7 *It is forbidden to buy or sell human gametes, fertilized eggs, embryos or fetal tissues.*

Article 8 *To conduct human embryonic stem cell research, you must conscientiously implement the principles of informed consent and informed choice, and sign informed consent to protect the privacy of the subjects. The informed consent and informed choice referred to in the preceding paragraph means that the researcher should inform the subject in an accurate, clear and popular language before the experiment, and inform the subject of the intended purpose and possible consequences and risks of the experiment and obtain their consent. Then let the subject sign an informed consent form.*

These provisions strictly limit the way human embryonic stem cells are obtained. From a legal point of view, there are obvious problems in the operation of He Jiankui's gene editing baby.

Judging from these regulations, although China has not yet introduced laws and regulations specifically for gene editing, it is very cautious about biotechnology, especially the biotechnology research and development involving human beings, to eliminate risks and ensure safety.

VI. Research Conclusions and Recommendations

Based on the results of a comprehensive empirical investigation and normative research, we can draw the following conclusions:

- Under the influence of hot news such as the He Jiankui incident, the public has a good understanding of gene editing technology and has a certain understanding, but this understanding is limited to the general understanding of major concepts and hot events, and the recognition of specific technical content. Knowing is limited, there are certain misunderstandings.
- The acceptance of genetic editing by the public is quite different, and the overall distribution is normal. That is, most publics are cautious about genetic editing. They neither fully support nor resist, but the specific context of genetic editing applications. Content depends.
- In general, the public has a high degree of acceptance of microbial, non-edible animals and plants, and human-made somatic cells for medical purposes, and has low acceptance of human embryonic gene editing. In addition, the public's acceptance of edible organisms gene editing is not high, which is more obvious in older people, lower education levels, and residential areas in rural small cities.
- Overall, the public's acceptance of gene editing is positively correlated with its cognitive level. That is, the more familiar with the gene editing technology, the higher the acceptance of gene editing. However, people with low cognitive levels often have the idea of "doing nothing," and people with high levels of cognition often think more about the safety, ethics, and social issues behind gene editing. It is also not high, resulting in a limited intensity of this correlation.
- The public's level of cognition and acceptance of genetic editing is significantly affected by gender, age, occupation, place of residence, level of education, and income status. The level of education is a key factor. The influence of these factors on the level of cognition and acceptance is more complicated, but in general, the longer the age, the lower the income, the lower the level of education, and the lower the level of cognition and acceptance of genetic editing. And the impact of these factors on cognitive levels is more pronounced than on acceptance.
- The public is particularly concerned about the safety and ethical issues of genetic editing techniques, especially when this technology involves the human body. When gene editing technology does not involve the human body, most people hold a strong pragmatic standpoint and generally support genetic editing of other organisms in the case of human-friendly conditions and technical security. "Do not respect other biological rights" violates nature. Law "The influence of one type of concept is very

limited. After the gene editing technology is directly applied to people, most people are cautious and pay close attention to the security, legal and ethical issues behind them, and support the development of “treatment” under the premise of technical security and institutional norms. For the purpose of genetic editing, against genetic editing for the purpose of “enhancement”.

- Gene editing techniques have led to a series of philosophical, ethical, religious and social debates. Due to the wide range of applications of genetic editing, the application of various objects, involving technical, environmental, ethical, legal, social and other factors, has formed a complex view of various factions. Due to their different backgrounds and values, this debate will continue for a long time.

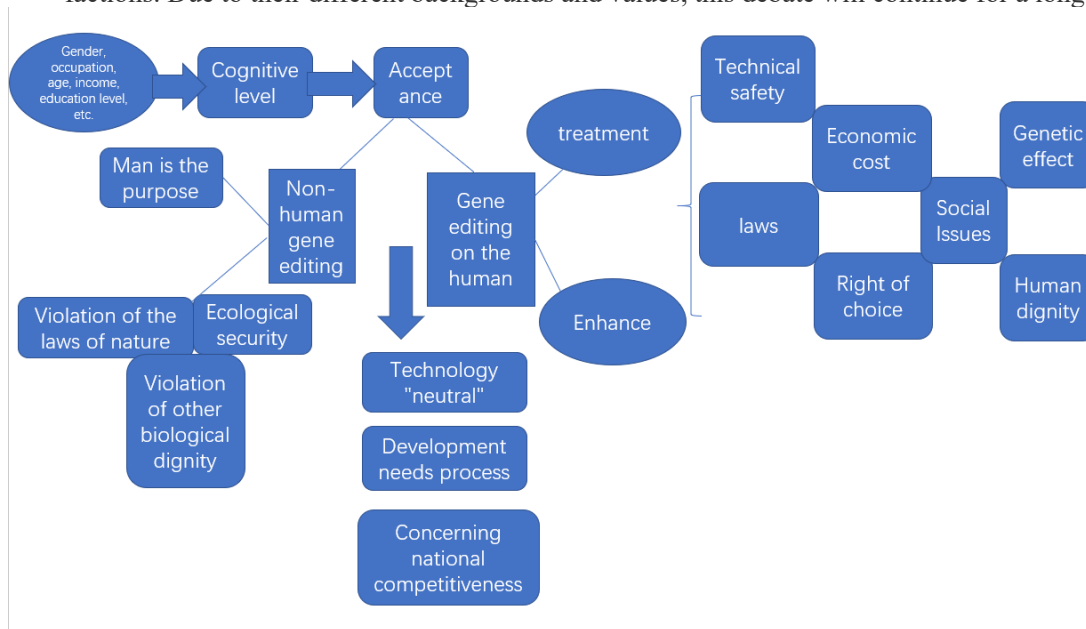


Figure 35 Summary of Gene Editing Controversy

- China has not yet issued specific laws on genetic editing related technologies. However, from the perspective of some relevant regulations, China has strict control measures on biotechnology such as genetic editing, especially biomedical technologies involving human beings. Be cautious, avoid risks, avoid disputes, and ensure safety while developing.

We believe that in the face of cutting-edge technology such as genetic editing, we must develop steadily and avoid risks. To this end, on the basis of research, the following recommendations are made:

- Strictly supervise the mechanism and issue special laws or administrative regulations on gene editing technology as soon as possible to regulate the development and application of gene editing technology.
- Strengthen the popularization of relevant cutting-edge science and technology, clean up the media's false and exaggerated reports, clarify the public's misunderstanding and understanding of technologies such as genetic editing, and raise the public's cognitive level.
- Actively promote the development of genetic editing technology, focus on solving the hidden dangers of technical safety such as off-target, and promote the maturity of technology. From the results of the survey, when technology is safe, most people support the promotion and application of gene editing technology.
- Under the conditions of ensuring safety, focus on the application of genetic editing technology in areas that are not subject to high public acceptance and ethical issues, such as the human body, to avoid large ethical and social problems.
- Strictly regulate and limit the genetic editing of the human body, actively explore genetically-edited genetic editing without genetic effects, and oppose or suspend the development of embryonic genetic editing with the purpose of “enhancement” or genetic effects and unknown risks.
- Establish a bridge of communication between scientists, humanities and the general public to promote ethical and social issues related to genetic editing. While popularizing scientific knowledge to the public, scientists should also listen to the public's views and expectations on scientific research and listen. The suggestions and ideas of humanities scholars enhance two-way communication, promote the connection between scientific research and the public, and the integration of science and humanities.

Through research, we take the cutting-edge hot but controversial technology of genetic editing technology as the entry point, and recognize the status quo of scientific research and public disconnection, science and humanity. The public has a desire to understand cutting-edge technology but is full of misunderstandings. Researchers focus on scientific research but relatively ignore the ethical and social issues behind science.

We hope that through our practice, we can arouse the attention and attention of scientists on the ethical and social issues behind science popularization education and science, and promote the connection between scientific research and the public, and the integration of science and humanities.

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Appendix I Questionnaire

A Survey of the Public Cognition and the Acceptance of the Gene-editing Technology

Dear interviewees,

The survey is conducted to understand the public attitude towards gene editing and other technical means. This is an anonymous investigation and the content is only used for scientific research. It is absolutely confidential. Please select the appropriate option according to your realities and views. This filling will take you about 5 minutes. Thanks for your support and cooperation.

SJTU-BioX-Shanghai
Shanghai Jiao Tong University

1 Basic Cognitive Concept

This module aims to understand your authentic views. Please fill in according to your own first reaction. Please do not refer to other people's opinions in the filling process. Thank you!

1.1 Self-evaluation of the cognition of related technologies:

Understand - deeply understand the principle or the progress of specific cases

General - have heard of relevant nouns or technologies and can give relevant examples;

Incomprehension - do not understand.

	understand	general	incomprehension
Transgenesis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gene editing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gene target therapy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DNA recombination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CRISPR system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1.2 The following events you have some knowledge of are: (Multiple choice. Select at least one item.)

Please select all the events you know; if you have no knowledge of the event, please select "None".

- He Jiankui's "gene-editing baby" in 2018
- Gene-editing "modified pig" as donor for organ transplantation experiment
- Improvement of yield of soybean by using CRISPR
- Human genome project
- None

1.3 How do you get information about gene editing techniques: (Multiple choice. Select at least one item.)

Please try to choose as comprehensive as possible!

- Paper resources(such as books, newspapers and periodicals)
- TV, radio
- Class learning
- Internet
- Common discourse
- No relevant information has been obtained
- Others _____

1.4 The genetic material of the organism is: (single choice)

Used only to understand the true cognition of the relevant areas, please do not search the Internet.

- Gene
- Protein
- Water
- Sugar
- Not known

1.5 Can the double-fold eyelids obtained by plastic surgery be passed on to the offspring? (single choice)

Used only to understand the true cognition of the relevant areas, please do not search the Internet.

- Yes
- No
- Not known

1.6 If a new gene is successfully transferred into the liver cell of the mouse, is the gene present in its progeny? (single choice)

Used only to understand the true cognition of the relevant areas, please do not search the Internet.

- Yes
- No
- Not known

2 Personal Attitude

This module is mainly aimed at personal views on gene editing technology, please fill in after thinking!

2.1 The degree of your acceptance of gene editing technology is:

Gene editing technology - A technique capable of allowing the human to “edit” the target gene, and realizing the knock-out and addition of a specific DNA fragment. In short, by means of the use of biological means, the man-made modification gene helps human to achieve a certain purpose, and such a modification **has a genetic effect** in some cases.

Mainly approve - understand and **will not object to other people's exposure** to gene editing products or the use of gene therapy.

Completely accept - understand and **will not object to your and other people's exposure** to gene editing products or the use of gene therapy.

	Resist	Mainly approve	Completely accept	Neutral./It doesn't matter.
Used in microbes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Used in non-edible plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Used in non-edible animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Used in food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applied to human medical treatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applied to human embryo transformation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.2 The degree of your acceptance of the following statements is:

	Totally agree	Agree	Neutral	Disagree	Totally disagree
Gene editing technology is the gospel of society.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The biggest problem of gene therapy at this stage is safety.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Even if parents think the modification is good for their children, parents can't choose to modify their child's genes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The development of medical treatment in modern society can not be separated from gene editing technology.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gene editing technology will further expand the class gap in society.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The modification of genes is contrary to the laws of nature, and there must be no good results in the end.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can accept gene editing techniques that work on non-human bodies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If the gene therapy is mature and safe, I'm in favor of its application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If a child has a birth defect, he or she can accept genetic editing with the consent of his or her parents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gene editors will create monsters and should be banned.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.3 In your opinion, in what order the following aspects should be considered in the process of gene editing and application promotion?

Please click on the options in order of priority to sort them with 1, 2, 3.

NO. ___ Technical safety

NO. ___ Economic cost

NO. ___ Ethic

3 Basic Information

This part of information will be used to confirm the classification criteria.

3.1 Your gender is: (single choice)

- male
- female
- Inconvenient to disclose

3.2 Your age is: (single choice)

- < 18
- 18~25
- 26~40
- 41~50
- 51~60
- > 60

3.3 The area where you live for a long time at this stage is: (single choice)

In this question, "big city" means: the provincial capital, the municipality, the Special Administrative Region and the planned cities (including Dalian, Qingdao, Ningbo, Shenzhen, Xiamen, etc.)

- rural area
- small-medium city
- big city

3.4 Your religious beliefs is: (single choice)

- None
- Buddhism
- Christianity
- Islam
- Taoism
- others

3.5 Your level of education is: (single choice)

"level of education" means the highest level of education or the current level of education while still in school.

- junior middle school or below
- senior middle school
- undergraduate college
- master
- doctor
- others

3.6 Your occupation is: (single choice)

- student
- Government / government functionary / civil servant
- Enterprise manager (including grass-roots, middle and senior manager)
- Ordinary staff (office staff)
- Professionals (e.g. doctors / lawyers / stylists / journalists / teachers / researchers, etc.)
- Ordinary workers (e.g. factory workers / manual workers, etc.)
- Business service workers (e.g. sales / store staff / waiters, etc.)
- Self-employed / contractor
- freelance worker
- Agriculture, forestry and fishery worker
- No occupation for the time being
- Others _____

3.6.1*(If you choose “student”in 3.6) Your major is: (single choice)

- Related to biology (Biology, Agriculture, Medicine, Pharmacy, etc.)
- Science /engineering (except biology)
- Humanities and Social Sciences
- Other _____

3.7 The level of your total annual income is: (single choice)

- None
- < ¥ 50000
- ¥ 50000 ~ ¥ 100000
- ¥ 100000 ~ ¥ 200000
- ¥ 200000 ~ ¥ 500000
- > ¥ 500000

3.8 Has your family / friend suffered from a “major disease” once or now? (single choice)

“major disease” refers to the items in the national major disease insurance.

- Yes No Not known

4 Supplementary and Extended Information (optional)

The following sections are optional.

Thank you for your support and understanding of the questionnaire. We will try our best to promote the positive use of synthetic biology, using our learning and collected data to serve the public!

4.1 (optional) Your supplementary views or suggestions on this questionnaire:

Thank you for your support! This part of the questionnaire is optional. We look forward to receiving your valuable feedback! Good luck!

4.2 (optional) If you are willing to have an in-depth interview, please leave your contact information:

It is recommended that you fill in your mobile phone number. We will not use your information for any other purpose! Thank you!

Appendix II Original Text of Interview in-depth

Interview I

Time: 31 July 2019

Site: Kunming

The basic situation of the interviewees: business managers, in his 40s, vegetarians

S: Hello, are you interested in modern biotechnology?

I: I am still very interested, and often read some of these aspects of information.

S: Do you usually come into contact with these products that use modern biotechnology?

I: I've been in touch with a lot of food like GM soy. Is there any harm to the genetically modified food that Cui Yongyuan made a lot of noise some time ago?

S: So what is your attitude towards genetically modified food?

I: I want to see if this is harmful to the human body. One of the simplest examples is cancer. The incidence of cancer is very high now.

S: Yes.

I: We used to live in trenches, and very few people have diseases such as cancer. When they moved to the city, more and more people had cancer, like some children with leukemia at a very young age.

S: Do you think there is a relationship between the current incidence of cancer and the use of these biotechnology? Or is it just caused by something else, such as environmental pollution?

I: I think environmental pollution is a very important cause, but I think biotechnology, especially genetically modified (GM) applications, has a lot to do with it. Because I don't think there's a way to determine if genetically modified food is safe right now, we may not be able to figure out some of its potential hazards until decades later.

S: Have you ever heard of gene editing?

I: Does the gene editor have anything to do with cloned sheep and cloned cattle?

S: They are different. Gene editing is a genetic modification of organisms, such as the gene editor baby that He Jiankui, from Guangdong province, did last year.

I: Ah, I heard about this. This matter is very famous,

S: What do you think of he Jiankui personally?

I: I don't think it's appropriate for him to experiment with people. If there is a problem simply from a medical point of view, such as being an organ, or if the child is born with a problem, with the consent of my parents, that is all right that I try it.

S: He Jiankui got the consent of the child's parents. His parents have AIDS, so if He don't edit, their children are also very likely to get AIDS.

I: But I think this still depends on whether the country has any legal provisions. If this is still not allowed in law, then it should still not be done. This is still based on the law.

S: But the law was not made for no reason.

I: I think if there is no legal prohibition, if the parents of his (baby) family agree, and if the risk of AIDS is high without editing him, he (He Jiankui) will not have a problem doing so. I think that's acceptable.

S: Do you think parents have the right to modify what they think is “defective” genes in their children?

I: it depends on what the genes are.

S: For example, if a child has some genes such as congenital diseases, do parents have the right to change these genes when their child is still an embryo?

I: I agree with this. I think it has the right. The simplest example is that abortion is allowed in China, that is to say, the baby is not yet an independent person, but I think it is unacceptable if parents want to make their children look better or smarter. However, if you know that this child is sick, if you do not cure him, he must not grow up, or congenital death. This happens around us, the child had muscle weakness, which is very scary. And after the age of 16, the child will not be able to grow up.

S: Even if he grows up, he may not be happy.

I: He is no longer happy, so I think this genetic modification, ah, should be allowed.

S: But once the technology is open source, it is likely to be difficult to regulate very carefully in the future, and some people may quietly use it as a baby enhancement.

I: So I just said that there must be a legal basis, not casually.

S: Do you think the use of this technology will make humans evolve and make the overall level of human beings stronger?

I: This is hard to say. Because if we don't aim at evolution, we aim at treating diseases, just to treat congenital diseases, such as color weakness and color blindness, I change a gene, and I change his life. The simplest example, like your biology major, it seems that people with color blindness are not admitted. In case there is a child with weak color, he is very interested in biology, through this technology can change his disease, then I think it should still be possible to try.

S: Even if he grows up, he may not be happy.

I: He is no longer happy, so I think this genetic modification, ah, should be allowed.

S: But once the technology is open source, it is likely to be difficult to regulate very carefully in the future, and some people may quietly use it as a baby enhancement.

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S: Some people may say that a person with a lower IQ, I can also feel that it is a disease or a defect, so I can make his IQ a little higher.

I: I personally think a little lower IQ is not that serious. It won't too serious an impact on a person. It's not a "defect."

S: Some people think they don't look good. I'll improve appearance.....

I: (interrupting) then I think there is a very problem. This is artificial interference. This is not appropriate. Unless it's a congenital defect, such as the hare lip, which can be modified.

S: But this yardstick is not easy to grasp. What belongs to the category of disease. What is he is not good-looking?

I: Foreigners have a point of view, that is, everyone is unique. Right?

S: Yes, there is such a view.

I: For a person, appearance is only a very small part, so many famous scientists, you cannot say how good-looking they are.

S: I mean, for appearance, some of us think it a disease, such as the hare lip or the cracked lip. But some of us just think it's simply not good-looking. But sometimes it is difficult to draw a line between the two. Which are diseases and which are simply not good-looking?

I: I think this can be defined.

S: Some people, for example, his forehead is a little too long or his nose is a little crooked, which can be regarded as a disease, or it can be regarded as not looking good. So how to deal with this kind of thing?

I: To tell you the truth, my personal view is that if the hospital thinks that this is a disease, it needs treatment, and it affects his future life and his future development, it is regarded as a disease. If it doesn't affect anything, or if it doesn't have too much impact, I don't think that should be counted. As you just said, IQ is very important. But as a social person, EQ, as well as your social experience, your experience, these are all more important, but you can't achieve it through any genetic editing.

S: That is to say, you feel that in the future, the country should define a criterion to determine which is editable and which is not.

I: Yes. I think gene editing is indeed a boon for some congenital diseases.

S: Do you support an adult who volunteered to genetically edit his own somatic cells?

I: I don't necessarily support it. This depends on what purpose he is for.

S: Does that mean it depends on whether he wants to cure or strengthen?

I: Yes. That is, you, ,if I have cancer and I have this technology, I will certainly support, whether it is right. If I just want me to be stronger, it's not good.

S: What is your attitude toward gene editing that doesn't work in humans?

I: I'm going to see if it's edible. If it's not edible and just a scientific experiment, I think it's acceptable. But if it's what we're eating, for example, a pig, if you change a gene to make it grow fast, I don't think it's unacceptable. I don't know if it's safe.

S: For example, we modify the genes of other organisms through genetic editing and transfer their organs to the human body. Because at present, there are not enough donors for human organ transplantation.

I: This is acceptable to me. There is a shortage of organs for transplantation in China.

S: That is to say, although this is finally used in the human body, it is still acceptable.

I: Yes, I can accept it. And especially in China, I think we should make great efforts to develop these.

S: Would you agree that some people, because of certain beliefs or religions, think that modifying the genes of other creatures is an act that does not respect life and violates the laws of nature?

I: I'd like to see what the purpose of this modification is. I've raised a pig and killed it. What's that called? Do not respect the life of the pig? Man is the master of the world. And it's impossible for me to think about it from the point of view of a pig. Many organs, like the liver, the kidney, including the eye, are still very deficient in China. So I support the development of these. As far as I know, there's a kidney in the organ transplant. I don't know how many years, it's about 400,000. We've only died two days before. It's because of renal failure. If there's a kidney source, I can live for many years paying forty thousand. But there's no way to get a kidney source at all.

S: That is, you think that human beings have the right to transform the genes of other organisms for their own production and living and for their own purposes, right?

I: This depends, I think if it is beneficial to human beings, then I accept.

S: That is to say, in order to benefit mankind, we can modify the genes of other organisms?

I: I agree with that.

S: Some animal conservationists will think that life is equal. We can't transform other creatures. We don't have this right.

I: I don't think so. Although I don't eat meat myself, being a vegetarian. I haven't eaten meat in more than 40 years, but I never think there's anything wrong with meat eaters. Plants are creatures and you eat plants. Therefore, I do not agree with the words "equality of all living beings".

S: Do you think we need to continue to develop gene editing now?

I: I think these technologies, especially for the developing countries like China, it is impossible not to study them. To be honest, if you don't, the rest of the countries are doing it. From the point of view of national security, ah, I think it is very necessary to continue to study. Even if I set up the law to specify which are available and which are not available; However, this technology must be mastered first.

S: So what do you think people should think of their place in nature when we have these technologies?

I: Human beings have always been dominant in nature. In particular, the more later the society develops, the faster it will develop, which is inevitable in the future. As far as I know, for example, energy research is developing faster and faster now. Nuclear energy is being miniaturized, and solar energy is being used. These are all major inventions that have changed mankind. Such as nuclear power plants, this absolutely reflects the dominance of human beings in nature.

S: Some people would say that because human technology is becoming more and more high-end, once there is a problem with technology, there are some places that human beings do not have a good grasp, the consequences will be even more unbearable.

I: Yes, so China must master this technology well while foreigners do. Of course, because I am Chinese, I am sure to look at it from the standpoint of my own country.

S: Yeah, that's right. But what they mean is that because the current technology is very developed, the consequences will be very serious once there is an accident, such as a nuclear leakage at a nuclear power plant, which will be very harmful and difficult to control, and then we will face a great risk of developing these technologies.

I: That can't be said like that. There's no accident in China like a nuclear power plant accident in Japan. So this depends on how well you master the technology, or depends on people. For example, I took a knife, but I mastered what I did with a knife. You can't say there's wrong with this knife. That is, tools, technology, these things are not wrong.

S: That is to say, technology is neutral, and the key is to see how people use it, right?

I: Yes. It's about people.

S: Finally, I would like to ask what do you think should be the most important thing to pay attention to when we develop gene editing technology now?

I: I think the most important thing about development is security.

S: Is that the security of its technology?

I: Yeah, you can't mess with it and do something you shouldn't.

S: It's as if it's ethical and regulatory, and it's not a simple technical safety issue.

I: Then I think we should consider ethical issues first. This problem is dealt with well, is the technical level of the problem. First of all, we should figure out what the purpose of using these technologies is. Such as the rich man relying on his property to transform a new life and then serve him, this is to be firmly opposed. But if parents ask for modification because of their children's congenital illness, then I think it is OK.

S: But some people will say that we do have to use techniques such as gene editing to help us treat diseases in the future, but in the process of technological development, there will inevitably be clinical trials, and some people will be sacrificed as experiments.

I: This also exists now, ah, some people have some diseases, go to the hospital, and the hospital introduces a certain new drug, for example, for cure cancer, there is no other routine method, well, if he agrees to do some clinical trials of new drugs, this is acceptable.

S: That is, as long as he has informed consent, that is acceptable.

I: Yes, as long as he agrees. Because he can't cure the disease, there may still be a chance if try the new drug. There are quite a few of these things right now.

S: Yes. Thank you for your interview with us today.

Interview II

Time: 2019.8.14

Site: Yueyang City, Hunan Province

Interviewees: 2 college students, about 20 years old

S: Hello, we are students from Shanghai Jiaotong University. We are doing an interview today. Would you like to answer a few questions?

I: Yeah.

S: Oh, thank you, gentlemen. So today is the first question to ask, that is, do you have a certain understanding of gene editing technology?

I1&I2: A little bit.

S: Do you think the biggest impact of this technology on humans is good or bad?

I1: Good.

I2: Since it is technology, it should be good to develop.

S: So what do you think is the gene therapy that is currently used in medicine? Will you use these technologies in your own body?

I2: (depends on whether he is expensive or not, ha) I think if it becomes a universal, social welfare project, it will certainly be acceptable, but if you turn him into an elite, medical service such as going to a private hospital in the United States to treat cancer, it may not be acceptable to most people economically.

S: The cost is too high, isn't it?

I1: Yes. Because I think it's a problem of cost. I think the current gene editing technology is not yet popular, so more may be an experimental thing. If one day you let me volunteer to do it, and you want me to pay, I may not be able to pay.

S: Do you have any knowledge of previous hot events about gene editing, such as the he Jiankui incident?

I1: What is it?

S: It's the event that edited baby genes.

I1: Yes, I think this thing may be too radical now, but I think this is actually the direction of development in the future. This man can't just keep it all the time. According to the present 100-year life span, the body will certainly not be able to do great things. There must be a way to either fly mechanically or join evolution, which may be the only two ways. This is dramatic, but I think this is the case. When the machinery is developing, the human body should be more and more high-end. To realize modernization, add kinds of external machinery, ah, directly to mechanical limbs, or modify human genes, changing some genes that may not be suitable for modern society.

S: So what do your opinion?

I2: What I think is about the same.

S: Then you are more supportive of the development of gene therapy.

I1: I support it. If you don't support it, it will become very expensive. It might get cheaper if support it. (laughter)

S: Do you support gene editing of human adult somatic cells on a voluntary basis to treat diseases?

I1: In terms of technology, there may be certain risks, and there may be some problems in the social impact. If you really want to be completely liberalized like plastic surgery, there may be ghosts and snakes. This is not easy to judge. In fact, this is the genetic level of plastic surgery. If you can accept plastic surgery, you should be able to accept this thing. They're essentially the same. Plastic surgery can also be very strange, which I was stunned to see. But this is not the reason why we oppose the technology, plastic surgery technology still has its irreplaceable role, for example, sometimes a large area of burning, some people may also be a large area of genetic burning. You can not give up those who really need it just because some people become ghosts and snakes. It may be similar to plastic surgery. And at the beginning of society, the

acceptability of society is not high, but slowly we will accept it and the legal provisions will be let go. I think it should be a similar process.

S1: It is assumed that some disease treatment can only rely on genetic modification. In this case, would you accept a compulsory treatment, similar to the congenital vaccine? What do you think of it?

I1: I accept all acquired compulsory vaccines.

S: Congenital means directly modifying genes.

I1: One of these is that if it is impossible to predict what the impact of the change will be, I will accept it, but as I said earlier, if it will be promoted as a broad social project, then it should be the same as the vaccine that children must be given at birth in society now. We can hear reports of vaccination accidents every year. Well, assuming that one day the congenital genetic modification will be forced, and you will certainly be able to hear the news of the accident. But I still have the point of view that we can't negate this technology because of this.

I2: That is to say, the present genetic modification is a future vaccine, is that what it means?

S: Yeah.

I2: Well, I quite agree with this view, that is to say, this kind of genetic modification may be a necessary way for technology and society in the future. But now I still take a neutral attitude, because I don't know much right now. I may not take the initiative to volunteer to participate.

S: Do you think there are still risks?

I2: Yeah, I still don't know much. I think most people think the same as me, not too agree and won't object, because it may be a new thing for most people.

I1: It might be the same as everyone's view of plastic surgery. You went to the street in 2008 to ask a 30-year-old uncle. You asked him if you accept your wife's change of face. I think the answer you get will be: shit, is there this kind of thing? But now you ask him again, that may have become the fact that happened around him, then you asked him if he supported it, he must have accepted it, even if he may have said in his mouth, "how dare you hurt or destroy the skin of your body that received from your parents?" But in fact, most people accept it, and you see reports of accidents and opposition every year, There is nothing wrong with the technology itself. Even if something goes wrong, it is also a problem of that person. It does not belittle that person. It is just that the operation is wrong.

I2: Is that the kind of mistake that happens once in a while?

I1: This is something that no technology can avoid.

S: You can't kill a litter in one fell swoop. So what do you think about using this technology for non-human beings?

I1: I think this is very unfair to cats, cats and dogs? (laughter)I have no problem with the transformation of people, and of course I have no problem with the transformation of animals. But you do have to pay attention to what if your modified genes outflow, which may cause damage to the ecosystem. For example, now there are some, ornamental animals and plants, ah, which may be changed to look a little prettier than others.

S: They're hybrid now.

I1: It's similar. For example, if I transform a pig to let it have a little more muscle, then it has the advantage of fighting, so assuming it spreads into the wild population, will the wild boar be better than it used to be? Well, the wild boar could not beat the tiger, but now that it can, then is it easy for the tiger to starve to death? Because the ecosystem itself is complex, you don't know what the impact of what's out there will be. But all you have to do is control it. You should promise this. Things do not cross with things outside, or only change the outside, do not change the genetic cells.

I2: It's like plastic surgery.

I1: Yes, I don't think it makes any difference.

S: The cost may be.

I1: Yes, the cost may be different. Isn't that about genetically modified crops? Now the biggest objection is that it may have an impact on the ecosystem, but now there are many ways to keep them from flowing out, such as just a second generation or something.

I2: The main thing is to put an end to genetic risks.

I1: There may be genetic pollution, because people usually add IMBA. If you have used this kind of project, you should not only make up a little pig, but also grow a bigger pig.

I2: It grows faster and fatter.

I1: In case this outflow, your mouse may one day become a giant mouse, which may be a little scary. This is not usually the case, but there is still a little worry, after all, this is also the classic opening of science fiction eschatological movies. There are any green people in the future, and superpowers. You have to watch Marvel's movies. Each one of them have a bit genetic edition. But it doesn't seem to flow out.

S: So what do you think is the prospect of using it entirely as a non-human, non-animal product, such as for storage?

I1: The future depends on whether you make money, or the reaction of the market. I can even accept your operate on human. I'm sure I'll be fine with your operation on animal appearance.

S: That is to use it as a product.

I1: You asked me if I was going to buy it, right?

S: Yes.

I1: Well, it depends on whether you have a substitute for the same function, or whether it's a pure market behavior. I won't buy it just because it's gene-edited, and I don't think it's bad just because it's gene-edited.

I2: It's mainly about the product.

I1: Yes, it is about whether it's cost-effective. Just like some agricultural products, the effect is exactly the same, you say non-genetically modified, that.....

S: Well, some of the chemicals produced through gene editing technology, or life-related things, would you use them if they exist?

I1: Supposing I have diabetes, I must use bacteriological insulin. I think it is certain, supposing your product is popular and the best, do not need white.

S: Anyway, as long as there is no harm to use it.

I1: There is no psychological disorder anyway. It's not a vegetarian or something. There won't be any primordial genetic protection associations in the future.

I2: I think there will be.

I1: I don't care, just like the dog protection society, I don't care.

S: What do you think we should pay most attention to in the development of modern biotechnology?

I1: Like other (technologies): I'm mainly concerned about two points, one that whether it can make my life better. For example, hybrid rice, it not only lets the food price fall down, but also solve some of the food problems. Another aspect may be that no matter what technology comes to the cutting edge, it can be used in war or deterrence.

S: Being used to transform human beings.....

I1: Yeah, in case you really do. Although I think it stays in the stage of modifying several disease genes and treating cancer now.

I2: Yes, is there legal regulation now, is the law permissible?

I1: Yes, once it comes to weapons, the government has to keep it under strict control. I don't want to see a biological and chemical crisis yet. We may have to pay more attention to these.

I2: But it's like all the technology ends up.....

I1: Yes, you study drugs, you can make poison, you study physics, you can make hydrogen bombs, you do chemistry, you may be able to kill 10,000 people? A thousand? Tens of thousands of them. It should be worth paying attention to what you study and use weapons in the end, but on the other hand, these can also be solved.

I2: Good use can solve problems, but bad ones.

I1: Pay attention to the two extremes. In fact, I do not want to pay attention to the middle ones, now some people are studying the human cloning. There is a game called Detroit human change. There may be real problems in the future. For example, in case they and we are not the same species after genetic editing in the future, there may be some problems. But I think we should actually let it go.

I2: The problem appears gradually and then we solve them gradually. Anyway, it is the problem of the second generation.

I1: That's not why we're worried about this technology. We don't develop robots if we're worried about robots?

I2: Worry about artificial intelligence and don't develop artificial intelligence?

I1: Isn't that half of the college students in China unemployed on the spot?

Interview III

Time: 2019.7.30

Interviewees: business staff, in his 40s

Site: Lianyungang City, Jiangsu Province

S: Do you have any interest in the current development of biology?

I: Not much.

S: What are the products that you are exposed to in life in general?

I: Genetically modified corn, wheat or something.

S: It's basically information from the news, isn't it?

I: Right. There are also biopharmaceuticals, biological agents, and so on, and some of the antiviral herbicides used to improve rice, which should also be relevant.

S: What do you think of gene editing technology?

I: I've seen the transformation of babies before. I don't have any attitude. I think it's acceptable if scientific experiments are carried out within a controllable range. But if it is uncontrollable, endangering ethics or social morality, it is not very good. Within the scope of monitoring, it is possible to have complete legal provisions.

S: That is, it has to be socially acceptable before it can be carried out, right?

I: Right.

S: Do you think some medical aspects of genetic modification of fetuses, or improvements are acceptable?

I: In fact, this is unfair. Rich people will transform their children into being more and more powerful, interfering with the law of natural selection. Artificial screening of people interferes with the natural evolution process, which may make class differences more obvious.

S: What if it's personal, it's not fetal.

I: It's the same truth. But like exercise, it's a kind of freedom, so my attitude is not very clear. In fact, I think that the technology itself is not right or wrong. The criterion of judgment is how to use it. The atomic bomb is not right for war, but it's good for nuclear power plants.

S: What do you think of an application that cannot be inherited, such as modifying somatic cells or using genetic editing to modify pig genes?

I: This is acceptable and can be used to treat diseases. And it is acceptable that it does not involve social and ethical issues at all.

S: So if using this technology to make biotechnology products, would you support them, such as biochips?

I: Yes, this is also a kind of scientific and technological progress.

S: Now there are already biological storage products on the market. The storage density of biological storage is much higher than that of physical storage, but at the same time, the cost will also be high. If it were you, how would you choose it?

I: It depends on the value for money of your product. For users only care about the use of experience, as for how it is achieved, that is the work of R & D personnel. But it's also the first time I've heard that DNA can do storage.

S: What do you think of the status of man in nature?

I: Man has the ability to choose in nature. Biotechnology is mostly used to make the human population develop. But it would not be desirable to selectively create some humans in this way, or to destroy some, like Hitler. However, it is acceptable to use this technique to prevent or relieve diseases similar to heart disease in the elderly or other diseases caused by old age.

S: The point is to consider the purpose of use, right?

I: Yes, there must be regulations to restrain them. Ethics must be balanced by the legal system and morality, and there must be security when there is ethics. It is very beneficial to human beings to solve the problem of security on the basis of first, and then to standardize ethics.

S: Safety is important.

I: What's the value of a technology that first achieves its purpose if it makes things worse because it's not safe enough. This technology is safe to achieve our goal reliably and efficiently.

S: Is that you think you need to walk steadily and then walk beautifully?

I: Right. If there is no ethical problem, then efforts should be made to solve this security problem.

S: What do you think should be paid the most attention to in biological development now?

I: How to let nature and human beings develop harmoniously in the limited natural resources. Can not let human development affect nature too much. Use biotechnology to regulate the way some resources are used.

S: Is to achieve a better balance, right?

I: Right.

S: Thank you for your cooperation.

Interview IV

Date: 20190815

Interviewees: female college students, about 20 years old

Site: Chengdu, Sichuan Province

S: Are you usually interested in modern biology, have you been injected with biotechnology or come into contact with some related scientific and technological products?

I: Is it very professional?

S: About the application of some biotech products related to life.

I: I've been watching a little.

S: What do you pay attention to? can you say it briefly?

I: Enzymes, genetic engineering, and then nutrition.

S: Have you ever heard of gene editing?

I: Of course, I've heard of it.

S: Did you know that there was a he Jiankui incident last year?

I: Gene editing the baby, right?

S: Yes. Do you have any views on this matter?

I: He went a little too far on the matter.

S: Can you tell me more about it? why do you think he went a little too far?

I: I heard that AIDS will attack a lot of sites, he modified the gene can only protect one of them. And after he modified this, he could not guarantee that nothing else would go wrong. And it is a modification made on people, so this is also a debatable thing.

S: OK, are you in favor of gene editing of human embryonic cells?

I: Well, I don't approve of it. If it goes on like this, it's either Superman or monster. What human beings will become?

S: If it's for some known potentially pathogenic genes, do you think parents have the right to modify their children's defective genes? For example, some congenital diseases.

I: Then they can choose not to have a baby. Now the law stipulate that if there is a problem with the embryo, you can choose not to have children?

S: There are some potentially pathogenic genes. Do you accept gene editing like vaccinations?

I: Like recessive genes?

S: It all includes.

I: Well, besides some recessive ones, what else are potential? It means that there may be some problems when you grow up in the future, right?

S: Right.

I: I still don't agree with it very much. Although it is similar to vaccination, this technology is not as mature as vaccine technology, is it? It doesn't necessarily work, and the price is bound to be very expensive. And after doing so, it may lead to new problems.

S: Do you think there is an essential difference between gene editing and plastic surgery?

I: I think there is a big difference between them. Plastic surgery does not involve genes, and it is non-renewable, that is, non-inherited, so the most cosmetic change is a person. Genes may affect the next generation, the spouse, and a lot of things. Because it can be inherited, it must be different.

S: Do you think the development of this technology will enhance or evolve humans?

I: It is also possible. Can you explain the definition of evolution? Does it mean to be better?

S: Yes, there are some enhancements to certain aspects of ability or characteristics.

I: Well, I don't think so. What if it becomes a monster.

S: In addition to gene editing of human embryos, do you support gene editing therapy?

I: I think we should discuss it separately. If he/she is sure that he/she will not pass this on to others, I think it is OK. For example, he/she already has children and does not intend to regenerate in the future.

S: Do you think a person has the right to voluntarily modify his or her genes?

I: I don't think he should be given this right.

S: Do you support gene editing of adult somatic cells on a voluntary basis to treat diseases?

I: I think it 's okay.

S: Do you think the biggest problem with gene editing technology is technical security or ethics?

I: I think there both are problem. Do you have to pick one?

S: Choose what you think is more important.

I: Then I think ethical issues are more important. Because the technology always lies in the progress, the present problem will always find the solution. But ethical questions will always be difficult to find an exact answer.

S: Would you like to receive gene therapy if it's safe in the future?

I: I don't seem to have any genetic problems. Then suppose I have, if I have selfish ideas, I will wait until

I get married and have children to give gene therapy to my somatic cells.

S: Do you support gene editing in non-human bodies? For example, for other animal and plant microbes.

I: I think this can be studied in the laboratory as a technology. But if you catch one on the road and let it go, I still don't agree.

S: Well, do you think humans have the right to modify the genes of other species for their own development?

I: I don't think so. This is too human-centered. Man is only a small member of nature, and it seems a little too much for his own development to harm the interests of other species.

S: Would you like to use gene editing products that have nothing to do with the human body, such as genetically edited chemicals, edited biological memory, and so on. Because there is now some storage through DNA storage or cell storage. The base of that DNA can be encoded, so it can be synthesized and edited.

I: Oh, then I should be willing, because it doesn't affect me. But the production process must be safe.

S: Generally speaking, do you think we should continue to develop gene editing technology?

I: I think any technology should be sustainable.

S: Do you think this is a violation of the laws of nature?

I: This depends on what genes to edit. I think it's okay if it's irrelevant.

S: What do you think should be paid the most attention to in the development of modern biotechnology? For example, technical security issues, ethical issues, economic costs and so on.

I: I think technical and ethical issues are really the most important issues. Then economic costs may have an impact, but they can be regulated, right? Macro-control or something.

Interview V

Date: 20190818

Site: Mianyang City, Sichuan Province

Interviewee: forty years old, housewife, freelancer.

S: Are you interested in modern biology?

I: I'm a little interested.

S: Have you paid attention to some related content of biotechnology in peacetime, or come into contact with some biotech products in daily life?

I: I've been concerned about something, but I don't seem to have come into contact with some biotechnology products so far.

S: Have you ever heard of gene editing?

I: I have heard of, for example, the he Jiankui incident, which became popular some time ago.

S: Are you in favor of gene editing of human embryonic cells?

I: If it's good for people, I'm in favor of it.

S: Do you have any views on the he Jiankui incident last year?

I: He Jiankui, after editing the child's genes, he will have antibodies to AIDS and will not be infected. This is still good for the human body. But if a large area of editing, complete genetic change, this is still not very good for humans.

S: Do you think humans have the right to voluntarily modify their genes?

I: I don't think I have the right to modify my genes without authorization. It is still necessary to apply for approval, step by step. If everyone can modify it, how do you want to change it, isn't it a mess?

S: Do you support gene editing of adult somatic cells to treat diseases on a voluntary basis?

I: If you treat the disease, I think it's okay.

S: So do you think the biggest problem with gene editing technology is technical security or ethics?

I: There must be both.

S: What do you think is the biggest problem?

I: It's still an ethical issue. I'm afraid of chaos.

S: So if the technology is safe, are you willing to receive gene therapy?

I: Under safe circumstances, I think I am still willing to receive gene therapy.

S: In addition to the human body, do you accept genetic editing of non-human bodies? For example, for microbes, animals and plants.

I: I think it is acceptable for non-human genetic editing when it is beneficial to the human body.

S: Do you think humans have the right to modify the genes of other species for their own development?

I: I think it's acceptable.

S: Do you think gene editing is an act that violates the laws of nature?

I: It is still a bit of a violation of the laws of nature, but for the better development of human beings, we still have to consider it comprehensively.

S: What do you think people should think of their position in society in the era of modern science and technology?

I: I think the position of human beings in nature should be in a favorable direction.

S: Can you elaborate on it?

I: For example, cancer occurs frequently now, and then many diseases do a lot of harm to humans. If I can, I think we can use editing to improve it and have the ability to be uninfected.

S: Would you like to use gene editing products that are not human, such as chemicals produced by genetically edited organisms, or genetically modified biological memory?

I: What I know at present is not very comprehensive, as far as I am concerned, I can accept it.

S: So what problems do you think should be paid attention to most in the process of the development of modern biotechnology?

I: The concern is that after the editing, ah, close relatives of ethics, ah, I do not know much about these relationships.

Interview VI

Date:20190819

Site: Mianyang City, Sichuan Province

Interviewees: female, bus driver, in her 20s

S: Are you interested in modern biology?

I: Yes.

S: Do you usually pay attention to biotechnology or come into contact with some biotechnology products?

I: yes, but not much.

S: Have you studied modern biological science and technology before?

I: It can be said that I have not learned fine knowledge or cutting-edge technology, the level of knowledge may be limited to the level of junior and high school, and a lot of things have been forgotten.

S: It doesn't matter. Have you ever heard of gene editing?

I: I've heard a little bit about it.

S: OK, have you ever learned about any hot events related to gene editing, such as the He Jiankui Gene Editing Baby incident last year?

I: I don't know much about it.

S: the He Jiankui incident is roughly to achieve the goal that babies will not suffer from AIDS when they grow up, because it may be possible to successfully realize that HIV does not work by attacking the baby's genes. So are you in favor of gene editing for human embryonic cells?

I: Maybe....No.

S: What do you think of He Jiankui's incident?

I: I think he's experimenting with uncertain techniques physically for his own benefit and ignoring national laws.

S: Do you think parents have the right to modify their children's "defective" genes?

I: Parents want their children to be good. It depends on which part of the defective gene it is. If it is harmful to your health, you can modify it. But no one is perfect, there can be many defects to make up for, if they make up for it, there will be no diversity of people.

S: Do you support mandatory gene editing like "vaccinations" for certain potentially pathogenic genes?

I: I support it.

S: Do you think there is an essential difference between gene editing and plastic surgery?

I: Yes, I do. Gene editing is not my choice, it is imposed by the will of others. Plastic surgery is mostly voluntary. Although plastic surgery may have peer pressure, the impact of social atmosphere, and so on, the final decision is made on its own.

S: Do you think the development of gene editing technology will enhance or evolve humans?

I: Yeah.

S: Do you support the development of gene therapy?

I: I support.

S: Do you think people have the right to voluntarily modify their genes?

I: I think they have.

S: Do you support voluntary gene editing of somatic cells for adults to treat diseases?

I: Yes.

S: Do you think the biggest problem with gene therapy is technical safety or ethics?

I: In the current situation, I think the biggest problem is the technical safety question

S: Would you like to receive gene therapy if the technology is safe after that?

I: I'd like to.

S: Do you support gene editing in non-human bodies, such as animals, plants and microbes?

I: Yes.

S: Do you think humans have the right to modify the genes of other species for their own development?

I: I think we can modify some, but we can't completely destroy other genes. To ensure species diversity, it is not necessarily that the good genes found now are good genes thousands of years from now. Society is developing. At present, what humans see is only a very shallow part.

S: Do you support genetic modification of other organisms to serve human production and life?

I: Yes, but does not alter all the genes of the same species.

S: Would you like to use some unrelated gene editing products, such as genetically edited biological chemicals, genetically modified biological memory)?

I: Yes.

S: Do you think we should continue to develop gene editing technology?

I: I think we should continue. After all, if society wants to develop, what is good for human beings can continue.

S: Do you think gene editing is against the laws of nature?

I: Yes. It seems that human beings forcibly rewrite the laws of nature to make it become beneficial to human beings.

S: What do you think people should think of their position in nature in the era of modern science and technology?

I: I don't think humans are at the top. Since nature can create human beings, it can also destroy human beings.

S: What do you think should be paid most attention to in the development of modern biotechnology? Are they technical, security, ethical, socio-economic, or other problems that you think may exist?

I: I think the most important thing is security.

Appendix III Communication records of humanities and scholars

A) Talk with Associate Professor Wang Qiu

Sun: Hello teacher Wang Qiu. I come to you today to discuss some of the ethical issues behind technology. We are now participating in an international competition in the field of synthetic biology. Our projects are closely related to gene editing, so I would like to talk to you, hoping to make a simple discussion of gene editing techniques from a philosophical perspective.

Wang: Ok, that's good. I want to know what you are doing now.

Sun: Our project consists of two parts, the technology that uses gene editing, on the one hand to report the problem of off-target; the other is to use it to develop the function of bio-storage - that is, we can store our 0-1 signal to Inside the cell, we can read this signal by adding the inducer. In theory, a cell can store one bit of information.

Wang: This project is quite good. You also want to explore the aspect of gene editing from an ethical perspective, right?

Sun: Yes. I would like to ask the teacher's overall view of gene editing. Is it accepted or not accepted or is it accepted to some extent?

Wang: First of all, there are many kinds of gene editing. For example, if I am editing people or other things' gene, I will have different attitudes toward different levels of gene editing. I can't generalize and talk about it.

Sun: Yes, gene editing has many different levels, for microbes, for non-edible animals and plants, for food, for human somatic cells, for human embryos. We are also doing a survey now, taking into account the gene editing of different objects and seeing the different attitudes of the public towards them. I would like to know which levels of gene editing are supported and which are not.

Wang: As far as I am concerned, even these crops and the gene editing of these staple foods are acceptable. Because of the evolution of organisms, these genes are constantly changing, only that the variation of these natural worlds occurs slowly. This gene editing is not a human intervention. The reason why we are afraid or rejected by gene editing is mainly because we have never encountered such a problem. To put it simply, in addition to the gene editing of the embryo, like He Jiankui's approach, creating a complete person to let him grow, may have many unpredictable consequences. For example, stem cell gene editing, to cultivate a new organ for transplantation, I think this is acceptable.

Sun: That is, it is not supported for human embryonic gene editing.

Wang: Right. As for the reasons, it is actually very complicated. We don't know much about a huge gene pool of human beings now. Will there be any other influences in the modification of several places? If the genes change, will it have some influence on other places, we don't know. This project is too big, just like if you build a house, we have to calculate how each structure is mechanically set. For the human body, we still know too little about it. If the next conclusion is even used to edit a new person, then I don't support it from the perspective of technical security.

But there are some reasons why ethicists oppose it, is not that technology is immature, and they even think that it can't be done after the technology matures. Some of them are for theological reasons, and people cannot play the role of God. But I think this reason for theology is not necessarily valid.

Sun: I used to see people who oppose the idea that people can't interfere with nature. He said that if you treat people as part of nature, there is no question of people interfering with nature. It is natural for people to do anything; if you don't treat people as part of nature, then anything that people do are unnatural and artificial, and there is no such thing as natural.

Wang: But this rebuttal is not very reliable. If people are part of nature, and it is natural to kill people naturally, then we cannot and do not care for him. This will become a self-defeating argument. It can't be said that because people are part of nature, people's activities are natural activities, so how people can transform themselves is a natural operation, we do not care about it. The man made a hydrogen bomb and then detonated it. It cannot be said that this is a natural activity and does not care for him. So saying such an argument is not a good argument.

A better argument is that man is a part of nature, so one cannot regard man as a subject of nature and the whole nature as an object. Man does not have this right between subject and object in nature, and does not arbitrarily modify it. This is a mild version of the argument. When we talk about reasons for opposing something, there will be a lot of controversy. These are the problems that ethicists need to solve.

Sun: We just want to understand all aspects of the point.

Wang: There are still some people who think that human beings are too arrogant. Although this is not a theological point of view, it is a fear of life, which can be called "quasi-theology." Although they do not believe in the existence of a supreme God, there is no creator like God, but think that the whole universe has its laws, life is worthy of awe, you can not intervene, a bit of the deism of nature. In fact, this kind of thinking like Taoism in China also has a little taste of deism. "Tao is natural." Therefore, as a creature, we cannot interfere with the operation of this heaven. This argument highlights a conflict between "the heavens" and "humanity."

Sun: But I always find it difficult to distinguish what is "the heaven" and what is "humanity", what is "natural" and what is "unnatural". In many cases, "god" and "people" are mixed.

Wang: Yes, I have considered this issue. I think this view is a bit untenable. In the case of our human beings using fire, in fact, the initial fire is a natural phenomenon. It should not be controlled by human beings as it is now. Anyone who takes a lighter can catch fire. Like the story of Prometheus in Greek mythology, we humans are "stolen fires", and then there is fire, which changes our diet and actually changes our genes. So this change started very early. In fact, it is not "natural" that human beings originally retained the fire. So this reason is not true.

So in my opinion, the best reason for opposing gene editing is simply technical immaturity and danger; there are also regulatory issues. This actually involves a human being's vigilance against modern technology. We used to think that science and technology is a tool. Good people can use it. The bad guys can also use it. It is neutral. It has no value bias. But in fact, in the past 50 years, many humanistic thinkers have felt that technology has its own nature. For example, I built an atomic bomb. Is it neutral? Is it a toolbox? Can't say it clearly. Because it is always a threat when it is placed. Like a nuclear bomb, or the biotechnology of this gene editing, if it goes wrong, it does not affect a small group of people. The technology of the past is only a small scope. This technology has been mistaken. For example, if the bridge is not built well, it may affect the villagers in the village to cross the river. However, if there is a problem with modern technology, its harm may be global. If we are eager to do it while the technology is not fully mature, it may cause loss of control. This kind of loss of control is not to say that the technology is in the hands of He Jiankui, but the technology itself is divided. For this reason, I feel that it is necessary for us to set up some ethical exclusion zones and to make some institutionalized norms.

Sun: Some people may say that if our ethical exclusion zone is set too strict, then technology may be difficult to develop, and it will not be perfected, and the danger will be even greater.

Wang: This involves a technical issue. I don't know if I can go through these experiments without a person like a monkey. Of course, animal protectionists may also oppose monkeys to experiment, but we always think that people are different from other creatures. This is our moral intuition. Sometimes we think about some ethical issues that will bring us some intuition, but you have to say that these intuitions are unreliable. If you follow up, you can't say it because these intuitions are a matter of fact and cannot be justified. You can't say that our intuition is wrong.

The reason why we have GM food today is also opposed by many people, or because our intuition contradicts it. We may slowly believe that gene modification is nothing through scientific communication, etc. We can cite a lot of data to show that these gene modified soybean oils are safe and can even be eaten in front of them. But for human beings to edit their own genes, to create such a baby, the moral intuition in this matter,

and the intuition of letting people accept gene modified foods, I think it is still a different matter. This is like “artificial man” in our intuition, we have no experience at all to deal with this kind of thing. If you say that we must come up with so many experimental products for the development of science, then I have to ask: How many trials can be finally successful? If this test fails, the test article is not an object after all. If the hybrid rice is killed by the insect, it will not work. But if this is not enough, it will involve some of the problems that we humans are most concerned about, that is, we Some of the rights of human beings themselves. Because each of us is a subject, we can change our minds and edit ourselves. If we edit our own children, many people will not speak. Editing our own human genes is completely different from editing the genes of any other creature. Microbial gene editing, plant gene editing, general mammalian gene editing, it seems to be a continuum, can be roughly analogized; but as soon as human gene editing, it seems that there is a gap, we have no intuition law crossed this gap. For some intuitions, reasons, and cases of other biological gene editing, there is no way to directly copy to human's own gene editing.

Sun: There are still some people who oppose gene editing. I feel that even after the technology is mature, people accept it. After large-scale application, there will be some problems. It may exacerbate the class division of society, and the rich will find ways to modify their genes better.

Wang: There is such a view. But I think the reason for their concern is not particularly good. Because rich people want to make themselves stronger, gene editing is a way, but there are still many ways. Even if there is no gene editing technology, class differentiation is already here. The gap between the rich and the poor has already existed. The rich have already mastered more resources and can better educate their children. Starting line”. It cannot be said that we do not allow gene editing to achieve communism and achieve common prosperity. This is not a good reason. However, this kind of problem does exist. Gene editing may indeed deepen the distinction between people's three or six, etc. It makes this class differentiation more serious. The rich people choose to pick the gene pool, and the poor can only naturally give birth. That is certainly better than the rich - but it is not the cause of class differentiation, because we have divided the class without this technology.

Sun: There are people who have a concern about “superhumans.” I am afraid that there will be children who will calculus when they are eight years old.

Wang: I think we have some genius-like characters today. It should be a favorite thing. The emergence of genius is not something that makes us feel uneasy. But the problem is that man-made to create a genius, genius does not become a strange thing, but it makes us feel that there is no room for imagination, no heroic feelings, we are happy to see the genius of Zhang Yitang, Turing is so remarkable People, because this is naturally selected, it is the result of the big game, but through the way of gene editing, we feel that it is cheating, what is great about that day? So instead we are afraid of the possibility of gene editing, rather than fear of having “superhumans” themselves, because we are worried that this sense of gaze is no longer there.

Sun: Actually, I think that what appears to be “superhuman” is a natural thing. For example, in the Middle Ages in Europe, even an educated adult may not even add or subtract points, but today's primary school students are also proficient. Therefore, it is not impossible for primary school students to calculus in the future.

Wang: In fact, human enhancement does not necessarily need to be achieved through a screening process like gene editing. Now someone has come up with a thing, just need to open a hair-sized hole in the back of the head, put a tiny chip into the brain, you can store 2T knowledge, you no longer need to start the GRE vocabulary every day. . So this way of combining humans and computers is not only possible but has already done something, and I think this way is two different things in ethics and gene editing.

Sun: I feel that there is no essential difference between implanted chips and gene editing.

Wang: This is not the same. Let's just say that it is very great for a person to walk seventy or eighty kilometers a day, but now that there is a car, what is one or two hundred kilometers a day, we will not panic because of the car. Similarly, if you are naturally high IQ, I can't help but admire you; but if you insert a chip in your brain so powerful, then I will not be convinced, I will feel that you are cheating, I also have Reversible punishment means that you have to take the chip out; but if the gene editing makes you so powerful, you cheated at the beginning, and it is irreversible, I can't do it, and it will be very unconvincing.

Sun: I don't think this can be a reason for opposition.

Wang: My reason is that if you insert the chip to make the IQ stronger, and your gene editing makes the IQ

stronger, this is two things. If we make the IQ stronger through editing, we will only say that this is nothing remarkable, but I can't take it for you. Because you are everywhere, you are better than me. But if another person implants the brain through the chip and makes the IQ stronger, we can have a set of social norms to prevent such things from happening. For example, the chip must be taken out during the exam to ensure social fairness.

Sun: But I feel that this is no different from myopia in surgery and wearing glasses.

Wang: It is true that surgery and glasses can improve people's vision, and one is reversible and the other is irreversible. But let's just say, if some professions can't wear glasses, then I can do an operation to restore my vision to normal. But if my gene editor transforms it, I will want to become like you and me in the future, and it will not change. It is already an adult. This involves a question of free choice. If my colleague has a person with a chip in his head, then we will say that we can't grab resources and compete with us. Then we will stipulate that in some cases this is not the case, the chip must be unplugged. But if we say someone who has edited a gene, we have no way to get him back. The society will look at him differently, the society will not accept him, and regard him as an alternative, not a 100% natural person. Therefore, when he is looking for a job, getting married, having a baby, or entering a society, he will be labeled as such. But if I am a person with a chip implanted in my head, I am in trouble. Ok, I took the chip off, I am just like a normal person, then it is OK. So they are different.

Sun: Actually, I think that in the early days of organ transplantation technology, the first people to receive organ transplants will be treated as heterogeneous. Including the first one or two test-tube babies, they will face the same dilemma when they enter the society. However, after the technology is mature and large-scale promotion, there is no such problem. Is the gene edited baby the same?

Wang: Well, there is a problem involved. The key to this question is how strong our intuitive plasticity is. Our intuition for some problems is more plastic. For example, regarding the left-handed question, in Europe, right is the meaning of the right hand, and it is also the correct meaning. Right hand means correct. So in the Middle Ages of Europe, a left-hander was considered to be wrong and was to be forcibly corrected. But today, who of us will discriminate against left-handers? Even we will think that he is very good, the right brain must be very developed. In the setting of some tools, we will also give left-handed some humanized measures. So in this case, our intuitive plasticity is very strong. For the problem of homosexuality, our intuitional plasticity may not be as strong, but at least in places like California, we are already accepting homosexuality; on the mainland, we do not seem to have. This is because of our acceptance of it, that is, the plasticity of intuition. Like an organ transplant, I have the same appearance as you. Even if you have a transplanted organ, you can't see it, and it's nothing remarkable. But if I say that I am a gene editor, IQ is two hundred, and you are just a natural person, IQ is only one hundred and three, how can you compare with me, but also very inferior, I think why I am They are better than him. Until one day, you suddenly discovered that he was a gene edited person. You have always been better than him because his intellectual genes have been strengthened. Then you will conclude that he was cheated. But the problem is that this kind of cheating has not been approved by him, only his parents have edited him. There is also a "right to choose". I did not agree, you will give me gene editing, and in the future, I will not know what kind of encounters and opinions I will encounter.

Sun: Regarding the question of the "option" of this gene editing, we designed two questions in the questionnaire survey. One question is: "Even if parents think they are good for their children, parents can't choose to gene edit their children." Most people choose "agree". But we asked, "If parents think that their children are born with defects, parents can gene edit their children." Most people choose "agree".

Wang: This is not contradictory. This should not limit the application of human gene editing in the future. A lot of questions, we can't just be "all or nothing" or "yes or no" attitude, but there should be restrictions and space. For example, it is true that both husband and wife have congenital heart disease, and the child born is likely to be congenital heart disease, and the couple has a very strong desire to have a child. If at this time, through some means of gene editing, the child can be transformed to restore his health. Under the conditions of mature technology, I think it is ok. But if it is a natural one, there is no family gene disease child, I just want him to look better or have more intelligence, just gene edit him, I think everyone still does not agree. This is also a question of political philosophy, that is, people are born unequal. Some people are handsome and beautiful when they are born. They are born in wealthy people, and resources are cheap. Some people are short and ugly, malnourished, and may have congenital diseases. This involves a problem of social redistribution. After they grow up, maybe I will levy a lot of taxes on the handsome and handsome person, which can be called "beauty tax." And the disabled person, he has congenital diseases, or short and ugly, this is not his fault. Although he is also working honestly, he does not have many opportunities. So society

should tend to subsidize him or give benefits. Therefore, a good, well-ordered society needs such a mechanism to operate. We already have such a mechanism, but in the case of gene editing, can we call such a mechanism, that is, the wisdom of institutional design can be used in the issue of gene editing, which is also an ethicist and political philosopher The problem that should be considered.

Sun: There are some extreme people who think that we should not compensate for this redistribution. For example, some diseases, we should not go to the treatment. He died before he was born, and this unfavorable gene will not inherit. To save him is not conducive to the development of mankind.

Wang: This argument is self-defeating. For example, if I apply this principle universally, then I can say that there is a person with a tendency to innate violence. He is a gene with murder, rape, violence. According to the previous statement, we should not Stop it and let him naturally eliminate it. If such a person is your neighbor, would you like it? You are not willing right away. Therefore, such arguments are incoherent. On the one hand, he said that people with congenital diseases should not be treated. On the other hand, for those who are inherently violent, he said that they must take enforcement measures. His argument is self-defeating.

Sun: Regarding this right to freedom, some people think that life is not free. The birth of a person is not determined by oneself. In this way, parents have the right to have children, and they have the right to edit their genes.

Wang: I used to have a sister. She said to her ex-husband: "I won't want children in the future. Because I feel that I didn't give birth to him without his consent. It's unfair." But we will feel that only rational people can have the right to consent. So what is the rationality of an embryo? Even said that one of my children is now two years old. I have to show some "autocracy" in some places, such as telling him not to tamper with the knife in the kitchen, not to play by the river. At this time, those liberals cannot criticize my "autocracy." Because a two-year-old child has no rational choice ability at all, he is not good at what is good and has no clear judgment. Pushing back, the two-year-old child has no complete choice, let alone an embryo? At this time, some kind of "authoritarianism" is necessary. But the problem is, if you intervene too much with him, then society will look at him with some kind of vision, and he will say that he is not a natural person, but a person who has been edited. This is a hurt after he enters society. Therefore, in this sense, parents can not do gene editing on him.

Sun: If one day, the gene editing technology is mature, everyone is gene edited at birth, just like we are vaccinating, then is gene editing becoming acceptable?

Wang: I think that society was already out of order at that time. Its management is likely to have problems.

Sun: That may be controlled by the state to enforce supervision. For example, it is stipulated by the state that it is forbidden to edit which genes, and which genes must be edited, just like what vaccines we must be born to.

Wang: I believe that such a country is unlikely to appear. Because this is a dictatorial regime. If I just want to keep some natural genes, the state can't, I have to edit this gene like a vaccine. At that time, the international community might have to fight. Because such a country dares to force the whole people to compile gene, then there are also developments in which biological weapons may create monsters such as "Warcraft." So I believe that it is unlikely that a country will dare to do such a thing. Because the pressure to face this is too great, it is a naked violation of human rights. This not only violates the choice of the embryo, but also violates the parents' choice.

Sun: But why can vaccination for infants and young children be successfully promoted?

Wang: If you don't get a vaccine, you will be at risk of getting a virus.

Sun: It may also be discovered later that if you don't edit this gene, you may be at risk of developing cancer, suffering from AIDS and other gene diseases. In other words, the vaccine is for infectious diseases, and the gene editing is for gene diseases.

Wang: If you choose not to vaccinate, and others have vaccinated, of course, the vaccine may not be effective, but you do not vaccinate you at risk of contracting the virus, which will bring great pressure to society. But if only gene editing can make me not have cancer, I choose not to edit this gene, it will not affect other people. It is not contagious.

Sun: I imagine that at some point, the gene editing is mature and the country will not force it to promote it, but most people choose gene editing when they are born. Then there will be a situation opposite to the present: people who may not choose to edit the gene will instead suffer from social repression and instead be treated as alternatives.

Wang: This is still the problem. That is how our intuition about gene editing today is variable and to what extent it is variable. Things like a vaccine, starting with everyone will be some resistance, like the beginning of vaccination with vaccinia also has a lot of resistance. However, there have been successful cases soon. Everyone will find that although the vaccinated person may not survive the outbreak, there may be fever, infection, etc. after the vaccination, but if I don't vaccinate, I will be infected. When a big outbreak, such as a plague or a smallpox, I will definitely die, or the possibility of my death is too high. Therefore, people's intuition is inclined to vaccinate.

Sun: But the moral instinct to be willing to accept the vaccine is still to be formed after a period of time after the birth of the vaccine.

Wang: That is of course, but the problem is that we can't judge the instinct of embryonic gene editing by trial and error. Although the gene edited child has not yet seen how much pain he has, the pain and stress he faces when he grows up and goes to society, psychologically, morally, and socially, may not be less painful than physical suffering. So we don't want to have more trials to try and test, to test our intuition. Judging from the current global reports, I believe that more than 90% of the people still disagree.

Sun: Do you think where the technology of gene editing should go now?

Wang: I think that the most urgent task now is to solve some diseases through gene editing, instead of creating some "new people" by gene editing embryos. Even in China, everyone's acceptance of gene modification is still low to absurd. Many people think that the word "gene modified" is very uncomfortable. Let me give you an example. I have a relative. He is a buyer in a canteen. He once bought a gene modified oil and was discovered by the boss. The boss was very angry and fired him, and he did not pay him the monthly salary. He said that he is going to "kill the people of the whole unit." My relative said: "I didn't pay attention to see if it was gene modified. After all, it was sold in the supermarket, and it was a discount. It was cheaper. I bought it to save money." But the boss is unmoved and thinks that gene modification is No way. It can be seen that many people now have irrational attitudes toward gene modification. This is a question that the whole society needs to temper intuition. But in the case of embryonic gene editing, I think that our instincts are almost right, and we follow our intuition.

Sun: Then we are now developing adult gene therapy, which may face problems similar to embryo editing.

Wang: It is like this. I am an adult now, with the ability to choose rationally, if these technologies are mature, then I may accept it. But the question is, how can this technology mature? This process always requires people to accept the experiment. This is a question of how a bioethics expert can make rules. You have experimented with monkeys and it is not the same as clinical trials with people. Therefore, on such a problem, I feel that as long as human beings still have dreams, there will inevitably be some gray areas. There may also be some "He Jiankui" hiding in the dark and doing some experiments.

Sun: This principle of bioethics has a lot to do with culture. In some Western countries, the "independence principle" is more important than the "favorable principle", but in China, the "favorable principle" may be more important than the "autonomy principle".

Wang: Right. Because we don't have the concept of "human rights". The concept of human rights is not in our tradition. Our rights subject has not been implemented on people at all. We are only implementing some communities like "home, country, and the world." The community is a larger value subject. In contrast, individuals only play a role in the community. So, indeed, our culture does not emphasize the "right to choose". Therefore, our intuition is closely related to the community we are in.

Sun: Individuals and the common community, there are often conflicts and conflicts between the evaluation criteria of the two rights subjects. For example, is the "favorable principle" in bioethics beneficial to the individual or is it beneficial to this community?

Wang: This principle of profit, I always feel that it is the principle of individuality. Because in any case, we have to produce an embryo for gene editing, which may be of some benefit to him, such as he will not get certain diseases or prolong life. But when we do some scientific research, it is more of a community's interest

to consider, and it may not be the individual interest of the individual. More is the future of mankind. Similarly, our current concerns about things are not more of a concern for the subject, but a concern for a generalized human future. The two can't be separated. The implementation of this technology is implemented on the individual, but after the technology is generalized, its trade-offs are the issues that we all need to care about.

Sun: Is there a problem with the “tram problem”, which is the choice between groups and individuals?

Wang: The “tram problem” is a conflict between utilitarianism and moralism, but there is not much that involves morality in this issue.

Sun: Maybe I am making an extreme hypothesis. After a person has done a gene editing experiment, our technology can be perfected. From the perspective of utilitarianism, it may be ok; from the perspective of morality, people are the purpose. Therefore it is not allowed.

Wang: The moral theory is like this. According to Kant's version, I should do this: I hope that the principles behind this can be generalized to everyone doing so. Switching to the Chinese version means “doing nothing to others.” For example, you can't derail because you don't want to be derailed. It's such a principle that people share this heart. In the case of gene editing, morality is basically not used. Basically, everyone considers it from the perspective of utilitarianism. Those who have a theological stand to oppose gene editing are just a morally constrained moral reason. This is not a question like “tram puzzle”, but a problem like “prisoner's dilemma” or “game theory.” You can edit your gene for three hundred years. I can edit my gene for three hundred years. Everyone can live for three hundred years. The earth can't bear so many people. In the end, it's less than 50 years. Have finished playing. That is to say, the interests of each of us are maximized, and the result does not maximize our total interests. Therefore, it is in the consideration of the consequences, the principle of utilitarianism, we are worried about gene editing.

Sun: Some people will use Kant's “people are the purpose can not be used as a means” to argue that we can gene edit other species, so that we can transform organisms, which can benefit us humans, but do gene for ourselves. Editing is not enough, it is to use people as a tool.

Wang: Kant said that there is a metaphysical presupposition behind his set, such as the human soul is not dead, etc., has his specific context and a set of logic behind it. Most of us think that the idea that “people are the purpose” seems to be right. For example, if you work in the boss's lab, you are working. What is your purpose? But Kant said that people can't just be tools. When the boss drives you to do these things, you must always look at yourself as a purpose, and this purpose is still the attribution of a rational subject. You are a rational person who has the power to choose and has the ability to act. When you are dealing with and distributing in society, you must consider one such principle. This is two things that we usually say “people are the purpose.” Today, I believe that few people still hold the idea that “people are the purpose.” Otherwise, these large-scale social cooperation is impossible, because in social cooperation, everyone must play a certain role, then the individual is not the purpose, the purpose should be that everyone can live together. It's your turn to release the wind tonight. You should go hunting in the mountains tomorrow afternoon. You should go into the mountains to collect the fruits the day after tomorrow. We all have our own roles and have our own division of labor, otherwise our community cannot be established, and each of us may not survive.

Sun: Yes, but in dealing with the relationship between people and other species, we always seem to have an intuition: people are special.

Wang: Yes, from a biological point of view, there is not much difference between human genes and genes of other organisms. Like chimpanzees and dolphins, their IQ is also quite high, and their gene similarity is also high. But the problem is that we have an intuition that there is an ontological gap between humans and other species. Because we are human beings, we have too many books and cultures to teach us that people and other animals are not the same. Like in ancient China, there is a saying that “the heavens and the earth are three talents”. People and the heavens and the earth are an ontological position. We will never say “the world is a cat and a cat”, even if you are a cat fan. Similarly, in the story of the Bible, we see that Adam and Eve were created by God in their own image, and these animals are named by human beings and are given to humans by God. From this perspective, it seems that there is a kind of other creature that can be used as a tool, and human beings are the intuition of purpose.

Sun: We also found a phenomenon in the questionnaire. When we use two levels of acceptance as a criterion for whether or not we apply it to ourselves, many people are accepting these new technologies without using them for intuition. But when the gene edited food or gene therapy is on himself, he won't accept it.

Wang: This is human nature. As long as it doesn't matter to me, as long as I can make a profit, then it is good, this is a natural psychology. It's hard to say that each of us is selfish or has an animal instinct. But this is also a very stupid idea. If you want your choice to be used by others, others will choose to be able to use it for others, and will eventually return to yourself. We all want to put ourselves out of the way, but the problem is that modern technology has involved each of us.

Here I think that if we want to develop gene therapy and need some volunteers to do clinical trials, then we need to give some compensation mechanism, and he will be willing to let this new technology be used for himself; otherwise he just thinks about you first. Used for others, etc. I am very mature and I am profitable again. For example, a seriously ill person, conventional therapy can't survive anymore. You tell him now that there is a new therapy in the experimental stage, it is possible to cure you through gene editing, and you can give you two million to bear this. Risk, then of course he is very happy. Of course, some ethicists think that even if he is dead, he can't let him accept gene editing. There may be various reasons. Of course, this is the question that the real bioethicists need to discuss.

Sun: In general, you think that gene editing in gene therapy for adult individuals of other species or humans is acceptable, and it is unacceptable for embryo modification.

Wang: Even if I am "acceptable" in gene therapy, there is a premise. This presupposition is the maturity of gene therapy technology. But the problem is that the maturity of this technology will certainly undergo some tragedy and trial and error. To be honest, if I am a national planner, on the one hand, this technology is now immature, but on the other hand, it does have development needs, and it will be beneficial in the future. I may only be able to slap certain things. Only one eye is closed, leaving some gray areas.

B) Talk with Associate Professor Fan Muyou

Sun: Today is mainly for us to participate in a science and technology project, because this is a foreign competition, we need to do something outside the laboratory, that is, to understand the possible social impact of this technology, so I want to do something from the philosophical side. Exploring, so I want to know what the teacher personally thinks about this gene editing technique.

Fan: I thought about it after you said this technology that day. I personally have been very opposed. I will say something that I object to. I have several reasons.

The first one is to determine a standard subjectively, or to judge the pros and cons, what is good, what is bad, but in fact, from this point of view, or from an ethical point of view, there is no absolute Good or bad genes, for example, the experiment it did in Guangdong, is to edit this gene. For example, this gene is not good, but if many of the genes of this pathological disease are considered bad, they are all edited. Then, if you develop this way, you will go to such an extreme. The heart disease gene is not good. For example, congenital heart disease or something, and then the mentality is flawed. You will feel that these are bad. Then this goes to a Extremely, I feel terrible, just like the Nazis preached, it is really that the people we go to a gene are excellent, that is, the artificial judgment, so I only want good Genes, extremes are like racist propaganda, I will think that blond is good, I will think that white skin is a good gene, that can be, then, for example, homosexuality, very Place, for example, China, this is a disease, and should it be edited, although I have not confirmed this aspect, but if everyone is like this, then we also edit the children to take With this kind of gene, I think this is very ridiculous. What standard do you use? Why do you think your standard is right, what kind of gene is good, what is bad, in fact, there is no clear standard. I think this is unacceptable. In addition, I think, in fact, many experiences tell us that each person's life experience is independent and unique. There are good and bad experiences in this experience. It is like being sick. AIDS is terrible. Leukemia, many of these terminal illnesses are of course a bad experience, but must they be the worst? I don't think it's hard to say that I used to go to the philosophy class to let the students discuss what is the most terrible in life. Some people feel that they are sick and sick, and that they are the most terrible. Some people feel that they are not the most bitter, everyone feels. It's all different. How can you decide that under the premise that everyone is unique, getting sick is the worst life experience, and many people may think in reverse, maybe many people do not have the terminal illness of AIDS, many people are very mediocre, looks like , Various aspects. Just like when it comes to AIDS, I think that Hollywood is a famous hybrid model, very beautiful, very delicate, very thoughtful, but got AIDS after marrying her first husband, but she chose to open her, she It's in the history of Hollywood, of course, in the 1970s, the first one to disclose his illness. At that time, there was no condition at all, and what he was treating, but she just lived a legend, so I will say that many People don't have this disease, and you don't live like a legend, you don't have talents and talents, not so absolute.

After that, I thought that including the first two days I saw an article on WeChat that also covered this topic. In fact, there was an article about this topic very early. In fact, it is in parent-child relationship. In psychology, why do women love children because recently? There is one because editing the newborn child, it involves this question, why do parents love children, is this a child or is he a good child? In fact, this is the topic that we often discuss. I don't know if you think about it. I have thought about this problem many times. I just assume that I am not like this. It seems that it is really not good. If there is no such good, no university experience, then My parents won't love me like this, so it's terrible to think about it, because it involves a less decent side of human nature. Many times parents love this child not because of love itself, really because this child has satisfied him. The expectation, then he will love him so much. When I was a child, I read an essay written by Bing Xin. She said, she asked her mother why you loved me, loved me, and her mother said no, why Bing Xin was very moved. This is the best language of love. My mother loves me not because I am Bing Xin, so good, because I am her child, it is only for this reason, but I think, especially the many parents who are now, He is projecting his wish to the child. If the child disappoints her, we see many problems in this kind of parent-child relationship. It's all because of this, the child is not strong enough to be obedient, why don't you have the job I chose for you, why didn't you follow my wishes when you got married, etc. In fact, it's because you love children, You are very simple, just can't say like Bing Xin, you love children because you are your child and love him, but you have misrepresented the love of parents for your children. You must be very good because of him. The extreme point, if the child is disabled or mentally handicapped, will your love for him be reduced? If he has heart disease or ADHD, autism, do you not love him? This is incredible. Shouldn't you love him unconditionally? If you want him to be good enough to meet your expectations, you will treat him like this. As long as he does not satisfy your expectations, can you take back your love? Or are you not so fond of him? From this point of view, this is equivalent to saying that if you do this, it is like a friend of mine. When I was pregnant, I first gave birth to one. Screening is mentally retarded, because at that time, he felt no matter what it was. As long as there is no deformity, even if there is a little obstacle, he feels acceptable, it should not be because of this, so at the beginning, everyone else advised him, but then he decided to give birth, so I said, extreme One point, if this is the case, will you give up the child?

Sun: But some people, he may feel that if you know that he has mental retardation or congenital diseases, you give him birth, but let the child suffer in the future.

Fan; in fact, the child does not know, this process of parenting is very important to parents, so it depends on your attitude as a parent, many people will, not to say a lot of people, but it will be a realistic reason, I feel that this is related to the education level of the parents and the family situation. In particular, there are some family conditions that are particularly poor. Some of the children I met, especially the teachers of the teachers in the Kochi University, are mentally handicapped, so they spend a lot. The energy to raise this child is really supportive of family conditions. You must hire a babysitter. You must send him to that special school. Then the parents really have to pay a lot, and they have to endure a lot of cold eyes. Laugh at you, for example, your parents are Kochi, how come this happens? But in principle, it's because of loving this child.

Sun: I have seen some of these children resent their parents after they grow up, knowing that they have this congenital disease and have to give birth to themselves.

Fan: Sometimes there will be, but I think it is still, it shows that parents have not raised well in the process of parenting. If you really care for this child, it will be a lot, not only the family, but also some support in the society. There are some conditions better than some countries. For example, in some countries with high welfare in Europe, if you are a child, you should send it to a welfare agency. The state helps to raise, but at present, this is a more extreme situation, but if parents really have this Psychological, I raise a child, if I don't want to go to trouble, what do you want this kid to do, or I just want to grow up according to my ideals, and then I can return me after I am big, but I think this is a very The idea of utilitarianism, to the traditional Chinese child-rearing, is a very utilitarian idea. Isn't it just to let him grow and make it a healthy and happy person? This is not enough. You are not trying to satisfy you. Time to put your unfinished wishes on the child, or the child to return him

Sun: I just said that it is also possible to judge whether this gene is good or bad. Some people take this vaccination compared with vaccination to eliminate certain diseases. Is it also with this?

Fan: In fact, many times, even in some developed countries, I am not willing to fight this vaccine. In fact, there is no need to fight the vaccine. The vaccine is not effective, and sometimes we know that there is this defect. Many times children may Because the vaccine has problems and is infected with new diseases, of course, it is not so absolute. Of course, the vaccine is now a more common one. Everyone can accept it. I know that vaccination is not the same as this, although I came to power. Knowing the principle of medicine,

that is to say, he is vaccinating for disease prevention and treatment, and will not interfere too much with human body function, but I think the gene editing is still different, because after all, it is irreversible, just like I used to have a friend, when he saw an advertisement for foreign cosmetics, said that changing your genes and reversing your aging, in fact, he just knows the psychology of women. If you listen, you will not buy it. On the one hand, you will definitely not get it. The other side thinks that the gene can't be changed, you can imagine his statement, very When we think that the gene is born, we don't want it to be changed, it may not be so good, but he is our own, just like the rebellious mentality when we are seeing a doctor. When we are seeing a doctor, adults may I will tell you, you don't want this, we are for you, but we may have done this. We will think that this is what you said, I have no experience, I have to go through it, just like the child did not go to travel alone. However, you will say bad, but how can you know if you don't experience it? I think it's such a heart. It may be our DNA, gene, maybe not perfect, but it's our own, even if it's not perfect. Can also accept,

Sun: If the technology is mature in the future, there is such gene therapy. If you are voluntarily accepted by the patient, do you think it should be encouraged?

Fan: This is the case. Of course, it should be worth encouraging. Before that, there was still a gene change after transplanting organs. Everyone has different choices. Some people choose not to accept them, but others have chosen to accept them. After receiving the organ, you don't know what will happen, maybe there will be rejection, and many of the organs donated for you are immediate relatives. If it is your relatives, do you have the heart? I think this individual, some people are willing to accept, as long as it can cure the disease, but I think this should not be an applied technology, I think it should stay in the experimental stage, because it does involve many ethical and psychological problems, otherwise it will not There are many oppositions, just as we say surrogacy, some countries are allowed, but many countries in China and Europe are forbidden. Because of many ethical issues, you may seem to be very successful, but maybe A lot of ethical problems have arisen. You have changed the genes. How do you know that there are no other consequences when the technology is not so mature? I don't know about this technology, but what happens when you change the genes? You don't have this disease, but other ones, for example, your intelligence has been affected, or others have received influence. Some people may think, for example, art, there are really many people with ideals, maybe not healthy. Important, as long as you can complete the artistic ideal

Sun: Just as we did a survey, many people are willing to support the development of this technology, but they are not willing to use it. I hope that after the technology matures, I will use this technology.

Fan: This is indeed the idea of many people. If you don't want to be a guinea pig, you will still worry that there will be some problems, and some irreversible effects will be terrible. It is like transplanting organs. Not everyone can accept it, let alone now. The technology is not so mature. As I have limited understanding, in the United States, there are some places where religious influence is more powerful. Such research will be opposed. Of course, some people with extreme extremes will feel that The theory of evolution will oppose that everything is created by God. This is tantamount to questioning God's creation and creation, so they are quite opposed, and they oppose him from an ethical point of view.

Sun: Like we definitely don't involve human genome editing, we are all involved in gene editing of bacteria, letting him serve humans. Do you think this is acceptable?

Fan: Other creatures, I have reservations, I will think so.

Sun: For example, the simplest single-celled creature

Fan: Well, I think there is no problem with plants and single-cell microbes. It may be because there is no feeling, but if it is a small animal, a cat or a dog, it may be because people have feelings for it, so they don't want him completely. They are instrumentalized. Although we often use them as tools and sometimes eat their meat, it is like some environmental organizations. Even cosmetics experiments are not allowed on animals. Of course, not everyone can be asked. I did this, so I said that I have reservations and I am not totally opposed. But if it is a small animal, I am still worried and causing harm. I think that sometimes people may become the most powerful living creatures. People are very arrogant at times, and they feel that they can be used for me. But from the perspective of Buddhism, all life should be treated equally, just as we did not consider them before killing pigs and slaughtering sheep. Feeling, but now in some countries in Germany are electric shocks to kill them, just like euthanasia, reducing their suffering, especially mammals, is intellectual, he Have feelings, too painful, so I think I'm not entirely sure

Sun: Especially when doing mammals now, they have to deal with them all the time. To kill him quickly,

not to let him have pain, there is a certain standard, a simple creature like bacteria. Is it possible to make gene editing?

Fan: It may not matter, it may not be completely felt. After all, microbes, don't want animals, give people such feelings intuitively, there is not much opposition, and microbial life is not as conscious as animals, so I think so is allowed

Sun: There are still some people who feel that as long as they are transforming creatures, they are playing the role of God, in violation of the laws of nature.

Fan: This is a kind of religious extreme. Even evolution is opposed. Just as in Christianity in September, God created the world in seven days. He completely believes in this. It is unacceptable at all. People exist on this foundation. I used to read that confession theory. I felt ridiculous at first. Even my parents gave birth to themselves. They should not be grateful. They should be grateful to God. They should be grateful to God. Even the nurses should take care of themselves. The most grateful thing is God. It is God who feeds herself through the nurse. Later I thought about it. He felt that God came to give life. God is above everything. In his system, everything in your own life is not as important as God. God is high, so the most thankful is God. It is based on this foundation, so he can't accept it at all. Even if it touches the creation a little, there is a little religious extreme. If it is monotheistic, he will have something like this. , Christianity, Islam, Islam, is the only true God creation, he is difficult to accept, but there are some people who are relatively open, believe that religion is not so extreme, and God is detailed, just like before As discussed in the free will, as in the Renaissance, we must consider human reason, the free will of human beings, that is, there are some relatively one-sided people, even if they believe in religion, they will also emphasize the role of human beings, the power of human beings, from this From the perspective of researching genes, studying DNA, and how to better serve people, I feel that, as you said, it is certainly possible to do research for people who can do some services for diseases and human health. If it is by changing the genes, I feel a bit simple and rude, so I said it is very difficult to accept, of course, he studies his analysis. It is also necessary. We are all educated by modern science. You must do this research to serve human beings, but it is very simple to change through gene changes and levels. I think this is a diversity of people. An irresponsible performance

Sun: Like a little environmentalist, it is not in the perspective of religion. It is not correct to think that it is wrong to change nature. People think that people should obey the laws of nature.

Fan: It is true that these years have this tendency, including the government. If you want to transform the environment and transform the earth, it will be greatly damaged. So some people will be more radical, that is, don't change. He is more harmonious. Including human destruction of nature and destruction of the biological environment, this species has been decreasing. If only human beings, each species lives on the earth, I think it can be understood from this angle, but it cannot be said. So radical, but how can we minimize the damage to him in the process of development, or find a way to live in harmony, not to say that people can dominate, people can rule, I think this is better

Sun: I used to see an argument that people should conform to nature and clarify what is natural. If you feel that you know a part of nature, then people do it naturally. If you think that people are not natural, then people Everything you do is unnatural

Fan: I feel that this is a bit of a sophistry. People are naturally part of nature. Naturally speaking, it is a lifeless one. It is a generalization, mainly an environment, but why people turn naturally against it because many times People are naturally out of a state of opposition, but people really should be part of nature.

Sun: There are still some people who oppose gene editing and feel that they have turned the tools into biology.

Fan: Then I feel that you have also made tools for eating and eating, no big deal. Including people sometimes tooling, can only say reduction, including the alienation of people who Marx said, how many people can not be alienated, can choose a job that is not alienated, including you as a programmer, there are several people who like it 996, I like to write code, but I have to do some work, just like we said, I hope that there will be less Shanghai for animals, but this depends on whether social and economic conditions can be achieved. Just like many slaughterhouses in China, it is difficult to give animals a Comfortable conditions, but we can't give it, can't be alienated, who is not far away, I also want to go to work at home, do what I like every day, but this is not possible.

Sun: But there is also a class of people who support gene editing extremely and feel that human evolution will be realized.

Fan: So this is what I said. It develops to the end like the Nazis, involving the best genes, but who decides this. Of course, many people think that the disease and the diet are not good, but this is no end. The horrible thing is that you can't stop walking on this road. At first you may just reduce the disease, then it will involve enhancement, what is like homosexuality, just like the Nazis, equal homosexuality and mental illness. And the Nazis believed that the Aryans were high-ranking peoples, other ethnic groups were inferior peoples, and even they were still occupying the area. It was terrible to treat local homosexuals as mentally ill and to "treat". If you are like this, you will be embarrassed. The terrible road, from the beginning is physiological, then spiritual, what, all you think you are mentally ill, you think he is not good, that is, ethnic, white skin, or black skin Ok, let's edit it. If the editing gene can solve all of this, then we have no diversity at the end. Everyone is as good as the Nazis. Aryan Well, inferior do not,

Sun: There are more from the perspective of enhancement, gene editing makes people stronger, and their intellectual physique becomes stronger.

Fan: And just as I said, everyone's life experience is unique. We want to say what constitutes a self, and we will know yourself in philosophy. In the end, there are many sayings about the self. The self itself is very complicated. That includes your own external, including your inner emotional character, your consciousness, your memory, etc. All this constitutes a complete person, then you say so, as long as IQ, as long as physical strength, this is not A complete self can not be said to be a development direction of people. Of course, technology is to be improved, but is it necessary to have higher IQ for everyone? On the contrary, we have seen many cases. If it is just that simple, people will find ways to improve IQ. It is too late, but in many successful people, IQ is not the deciding factor. We are not every athletes. Although the IQ is not so high, it is very happy. What I can do is, just like some people think that Jiankang is not so important. There is no uniform standard. I have seen many people with high IQ, 200 or more. Not happy at all

Sun: In an era like this, human beings have mastered many such technological means. How should we deal with the relationship between human beings and natural science and technology, and where people should put themselves?

Fan: As I just said, people don't feel that they are a master. As you said, directly changing people's intelligence is very high. This is very terrible. People feel that they are gods and they are the masters of the earth. I think this is terrible. It makes the environment and nature worse and worse, makes the species more and more single, and has empathy for the same kind. For other creatures, at the very least, we can see it. The creature, you should also have empathy, can feel his pain, can not stand in a dominating angle, the more you feel that you are strong, you have empathy in Vietnam, just like your IQ is very high, you will Viet Nam is empathetic to other people. If you go to a better school, you will look down on other people. This is terrible. That is to say, this society does not rely solely on human intelligence. If there is only intelligence and no good morality, then In fact, it will be counterproductive and even destroy the world.

Sun: Humans now have such a technology as gene technology. How should he treat him? On the one hand, there is always one, and the other is to receive environmental restrictions. How can we make the best use of technology and to better serve the society

Fan: Just like when there was a cloned sheep, there will be people worried about whether there will be clones. It should be said that this technology can be achieved, but it will not develop the technology of copying people. We are worried about some advanced artificial intelligence. That is to say, this technology must be used with caution. It is a bit of a feeling of opening Pandora's box. You don't know the consequences that he may cause. Many times, everyone is coming from a good side. For example, if you can copy a person, I will come. I'm sick, I can use his organs, but you can't get from the technical image, he may cause ethical problems and legal problems, and let him have no consciousness, even if he keeps lying in the incubator, it is inhuman. Let him be conscious, especially if he is the same person as you, then your relationship with him, gene editing is also, and finally it may be similar to this, gene editing becomes another person, only used for basic Later, it may be used to edit physical fitness, edit IQ, and even remember, but is this person still the original person?

Sun: The teacher studies Buddhism and Indian philosophy. Does it have some inspiration for us to deal with the relationship between man and nature today?

Fan: Many, we originally had a professor from the German burger, who is doing Buddhism. He has been writing books since he retired. He is also influenced by Buddhist thoughts. He later became a determined environmentalist and traveled even with planes. If you don't do it, the plane will destroy the environment.

When you get there, you will take the train. His book is about Buddhism and nature. The Buddha is talking about the life of the people. You don't know what the next life will become, and even reincarnation. To the animal, you certainly hope to suffer less pain, so it is also true that the Buddha talks about the life of the people, including you see this little flying insect, maybe your past life is your parents and friends, so he will wait for this life. There are many equals in life, and there are many such things in Buddhism, depicting the ideal world, what is the pure land, just like the tropical rain forest of India, there will be lush vegetation, blooming flowers, birdsong. Ah, what is similar in this way in Indian philosophy, he has a lot of the world's hidden world Body, why do he practice Yulin and very flat, he also feels that this principle can only be realized in nature. Indian philosophy is also adult reincarnation, and it is the same as Buddhism, as long as it involves this reincarnation, It involves an attitude towards her creature, is equal to nature, and is equal to other creatures.

Sun: Is it a little unacceptable for modern society to talk about it from the perspective of reincarnation?

Fan: India still believes in this, which is why going to India can see a lot of people in harmony with nature, don't go back and kill them, the streets are stray dogs, even cows, you are hard to see elsewhere. Of course, you can't believe in life and death, but they believe in biological equality, just like in Indian philosophy. In Hinduism, there is a creation god. Like in Buddhism, there is no creation god. Everything is caused by cause. Since all are generated by karma, then everything is of course equal. I think that India still believes in the harmony between this person and nature. His natural environment is relatively well protected. In addition, he has long been circulating non-violent, non-killing. They are particularly concerned about this, can not kill lives, until now, their society believes that they will not kill, of course, in China, this may be slightly, the Chinese feel that it is not so practical, the Chinese do not have this tradition, and most people are not so vegetarian, But many people in India are vegetarian, so yes.

Sun: There is also a view against vegetarianism. There is a food chain in nature. There is nothing wrong with eating other animals.

Fan: It's also reasonable. Just like some people say that eating plants, plants are also alive, but like microbes, they can't see, it's hard to produce empathy, but animals, you can see, you have Feeling, you can't accept eating some wild animals. I can accept some animals raised by people, but I still feel that I should be kind to him a little. If conditions permit, let him suffer less.

Sun: I remember that there is also a story in Buddhism. The monks cut the meat and feed the eagle. An eagle wants to eat the pigeons. Then he meets a monk. The monk does not let the eagle eat the pigeons. The eagle says that he does not eat the pigeons. He has to starve to death. I cut my own meat and gave it to the eagle, but there is an objection. The monk is also a life. You are not hurting your own life.

Fan: But this story is mythical. At first he felt that the pigeon had no meat. He could use his own meat to save the pigeon. I didn't expect the pigeon to be so heavy. Then he could only put himself on, but he wanted to say "The truth of all the lives, etc. The end of the story is also said, the gods began to test him, and finally the gods were touched by him. Similar to the nature of Christian mythology, Buddhism itself is very opposed to suicide and hurts itself.

Sun: The story also has a certain practical significance. We often face such a situation. On the one hand, you want to protect the environment. On the other hand, protecting the environment may mean that workers are unemployed.

Fan: This is the beginning. Why do developed countries can do well now? They will pollute the environment at the beginning, including countries like the United Kingdom. At the beginning, pollution is very serious, but it will not always be the case after development. Japan is that after the destruction of the environment, it has caused many disadvantages, including heavy metal poisoning incidents such as Minamata disease. Developed countries have done this at first. Later, they realized that the harm of pollution has a process of transformation, which is related to technology and financial resources. The industries polluting the environment are transferred to developing countries. As in developed countries, there will be no low-end industries, such as the clothing industry and the footwear industry. Even if there are, some high-end industries and high-end technology and new industries are left behind. The low-end industry has moved away. There is a process. Just like a few days ago, one of my friends mentioned that Switzerland, a very developed country, because that country is only the most high-end industry, the added value of products is very High, for example, we all know that he is making watches, making luxury hand-made watches, no factories, no pollution to the environment, and The oil used on the plane, one milliliter is more expensive

than gold, only to do this high value-added product, then of course he does not have to cause too much pollution to the environment, and it is a small production to maintain high profits, so this There is a process. If our technology is not achieved, we can only do low-end industries such as foundry. The light industrial products to the world are almost all made in China. Many developed countries can certainly do environmental protection because the technology is achieved, don't worry. Affecting employment, and even promoting employment, turning environmental protection into an industry, Sweden or that country, garbage classification is made into an industry, but in general, developing countries can't hit it. It is indeed a process. After all, We started the night, they have been developing for hundreds of years, and they don't think about protecting the environment at first. This is related to your technical and economic foundation and your consciousness. If you want to be an Indian, you don't have the special emphasis of the West. Rational development, this aspect is weak, although the industrial development is slow, they don't care so much, maybe they are chasing the spirit as a whole. To be stronger, we may be more utilitarian, of course, not completely utilitarian, but he may be more concerned about what the spirit is free of. He does not care so much about real industry and technology, and his destruction of the natural environment will not Seriously, his commercialization will not be so high. When I went there, I felt that the place where he traveled was completely uncommercial compared with the domestic one, and there was no development at all.

Sun: The teacher also mentioned the "Bhagavad Gita" when he was in class. It advocates not to consider the consequences. Let's do it first. Some people say that we have to use this gene editing technology now, as for the consequences. Let the people in the future correct and correct, how to see this statement

Fan: That is the world war in Indian mythology. His context at the time was equal to saying that you are this class, and you must fulfill your obligations as a class. But if you say that you have this technology, you don't think about it, then it's a bit different. After all, the two world wars are completely different from the current environment. At that time, we should consider reducing casualties, and now it is different from using technology to cause damage. During the period, death may not be so careless, but modern society is like Kant. Even if an individual should not be used as a tool, Kang is not talking about kindness. He also talks about tools. He is very opposed to using people as tools. He believes that everyone's independent spirit is precious, so you can't and should not use individuals as tools. The cost of such trial and error in modern society is too great.

Sun: But we are developing new drugs now, there will be an inevitable human experiment process.

Fan: But it can't be built on the basis of sacrificing the lives of others. We are not the one who will be ruined. We should respect everyone. As I understand, everyone has their own independent life. How do you know? What you arrange is what he likes, even parents can't do it, let the child live a specific life, or they don't love children or anything, but it shouldn't be like this.

Sun: If some people have nowhere to go, for example, if the person who sells the kidneys stands up and wants to be a trial, should it be allowed?

Fan: This should not be encouraged, nor should it be supported. It is true that he has no way to go, but why the state prohibits the sale of organs. If you do not legislate, it is equivalent to acquiescence. If you do not allow it now, you are so crazy. If you allow it, then There will be a lot of involuntary and persecuted, including some urban legends being cut off from the kidneys. Although I don't know the true and false, once this kind of sale is allowed, it will really make this kind of thing embarrassing, huge profits, Like drug trafficking, as Marx said, when the profit reaches 100%, it can trample on all human laws.

Sun: Some people hold the opposite view. It is because of the prohibition that the black market is rampant. If you are legal, you can regulate it through open supervision. For example, in some countries, the legalization of prostitution and drug trafficking can be standardized through open supervision.

Fan: But I am always opposed. This does involve ethical issues. Once it is released, it is very difficult to supervise. If it is cracked, it can also take moral justice. But if it is to supervise, it is very difficult. It is a controversial thing in itself. It is difficult to give proper supervision in the gray area. Maybe your original intention is good, but it will cause distortion in the back. I have seen it abroad, but I don't think it It's a good one, it's worth learning. He can't even control it himself. The red light district in the Netherlands is a place to hide dirt. There are all kinds of dark trades, and it is also very unsafe. So why should you allow this? The place exists, it's so crazy when you hit it, it's going to be more rampant when you let go.

Sun: In this case, the public is increasingly worried about modern biotechnology. Should this technology still be developed?

Fan: Worry is because the developers have not done a good job of popularization. People like us often don't know much about the specific details. They can only infer what kind of harm may be caused. For the public, on the one hand, they should improve their scientific awareness. If you know more about this thing, you won't be so scared. The question of the appropriate degree should be there. If you can't come out, you will be supported by this kind of ethical edge. This is terrible. It must be the existence of different voices. If there are doubts, then there is development. So you have to find a way to answer your doubts, try to avoid possible harm, and achieve a benign cycle, not to pursue one-sided pursuit of gene good or bad. Standards, not one-sided pursuit of superior genes and superior races, once this concept of good genes is available, like the Nazis, if there is good, there will be inferiority, causing the editor to discriminate against natural persons, like me. The friend said, when he accompanied his plastic-faced friend to the hospital, he would see those who had been plasticized would look down on undressed people. It is terrible, then he will feel that I am "reinvented", my current image - net red face, beautiful and Fan Bingbing, you still have to renovate this way, this phenomenon will occur, People who have edited will think that the person who edits the gene is very low.

Sun: Is there an analogy and similar phenomenon like gene editing and gene editing?

Fan: It's a bit like, there are similar places, but maybe, how to say it, it's not so serious, I think, a similar place will form a state of mind, I think the cosmetic is beautiful, maybe the gene editing is not A better gene, but it will form such a distorted mentality, accompanying my friend to a cosmetic friend. He was only a micro-cosmetic at first, and then the whole face was gone. It is also a reason like gene editing. Once released, he It's impossible to edit only one gene, from the beginning of the disease, to the spirit, to the intelligence, to the character, such as the grouping of less gregarious programming. In fact, you are always setting a standard. The group is good, the group is bad, So who can make such a standard? The same is true for cosmetic surgery. To set a standard, Fan Bingbing is good-looking, Angelababy is good-looking. It is best to have everyone out. The same is true. Many people would rather have the same face as others, not a unique one, just like you said. Voluntary is equal to giving up your own life. Everyone's life is unique. Like your face, your parents give it differently from others. You have to be the same as others. After all, the plastic surgery has a template. Finally, infinitely close to the standard template, when editing the gene is also a truth, certainly there is a template, and finally edited into the same person

Sun: Is it true that people who are doing biological technology should communicate with the public and understand the aspects of the public's desire for technology applications?

Fan: I think the direction, one, the public must know, or like a lot of people who don't know the aftereffects, they are all going to be whole, another, public feedback, although you may not have to accept this feedback, just like we usually take classes. , evaluation, if the students did not come to class, did not understand, then why he gave me a comment, this is also a truth, if the public can not fully understand, then it is not qualified to give feedback

Sun: Although a lot of science is done like GM, but the public is worried, misunderstanding, there are many

Fan: I think that on the one hand, it is the influence of the media. On the other hand, the public is more interested in this kind of publicity and the stars like Xiao Cui, and they are more willing to believe them, although they may not have this professional credibility, instead I am willing to believe the opinions of experts and feel that experts are kidnapped by interests. Finally, the media public is a means to understand the mass media very well, and many of them are only reasonable, do not understand the laws of the mass media, and do not use popular universality. The way to promote, of course, this is also related to the media, and finally did not get good publicity. So this propaganda is very difficult to do. I can understand that just like we sometimes have to talk about a very academic thing, there may not be many people who are willing to listen, but if you tell some legendary stories, you are very willing to listen. This is also very helpless. Very academic things, we must make this kind of propaganda, but not like this, there is no audience and attention. After all, you can't expect the scientific literacy of ordinary people, many of them have not received higher education, and may be more willing to accept the media. Some may be sensational, and many people will take the opportunity to engage in some nationalism. How do Americans do it, dump it into the country, and catch such a banner, it will be very sensitive.

Sun: We also did some investigations. We don't know much about the specific technical public, but it's a high-profile event like He Jiankui.

Fan: After all, since the media is very developed, many times I don't want to pursue the real thing behind

things. Instead, I use some sensational headlines to attract attention. Many people don't know what is behind. I was concerned because he was involved in academic fraud. The project was not approved by the ethics committee, and he made up his own cooperation with Stanford.

