

# Research on Taijiquan Based on Fuzzy Comprehensive Evaluation of the Cultural Inheritance System

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**Abstract:** It is known that Fuzzy comprehensive evaluation can eliminate multiple uncertain factors, and obtain accurate score zone. On the basis of this evaluation, the paper, combined with fuzzy comprehensive evaluation, attempted to evaluate Taiji types of exercises culture. During evaluation, the paper firstly established a set of factors related to four fields: life and humanistic thoughts, moral education, harmonious philosophy of life, and physical strength and tenacity. In addition, the paper also established a detailed evaluation set of futuristic view of life, impact of humanistic thoughts, harmonious society, anti-setback capacity as well as other aspects in inheritance of traditional cultural Taiji types of sports culture. China's traditional culture has greatly contributed to contemporary life and social values.

**Keywords:** Cultural inheritance, Fuzzy comprehensive evaluation, Fuzzy evaluation, Public health, Taijiquan.

## 1. INTRODUCTION

Taijiquan, affiliated to China's traditional boxing, is of great significance and nowadays, is widely propagating to multiple countries and regions. In the process of the publicity of Taijiquan, China holds "International Taijiquan (sword), push-hands competition" every year, in which Taijiquan was listed as a formal competition in Beijing Asian Games in 1990 [1]. With vigorous publicity of Taijiquan, followed by releasing policies of "national fitness", it is even popular among men and women of all ages [2, 3].

From Table 1 it can be observed that Taiji exercises adapted by the people of different age groups, showed that Taiji exercise can be healthy for middle-aged and aged people, and can also strengthen them physically and psychologically. It can also improve citizens' overall quality of life [4, 5].

**Table 1. Taiji exercise and age group.**

Age	45-59	Above 60
Start to exercise	100	95
Gradually adapt	120	110
Adapted stage	130	120
Remaining stage	130-140	120-130

## 2. MODEL ESTABLISHMENTS

Utilizing fuzzy comprehensive evaluation, following steps are followed:

(1) Creating factor set  $U: U = (U_1 \ U_2 \ \dots \ U_k)$

(2) Creating judgment set  $V$  (evaluation set):  $V = (V_1 \ V_2 \ \dots \ V_n)$

According to the general evaluation system, evaluation grade domain is defined as:  $V = \{V_1, V_2, V_3, V_4\}$   
 $= \{\text{Very good, good, normal, bad}\}$

(3) Establishing judgment matrix by fuzzy mapping from  $U$  to  $V$  to obtain fuzzy relation as the following matrix shows.

At first, for  $u_i$  with several factors, making an evaluation expression  $f(u_i) (i=1, 2, \dots, n)$ , gives  $U$  to  $V$  fuzzy relation  $f$  that is:

$$f: U \rightarrow F(U)$$

$$u_i \mapsto f(u_i) = (r_{i1}, r_{i2}, \dots, r_{in}) \in F(V)$$

By fuzzy mapping, fuzzy relations are obtained:

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

Fuzzy relation  $R$  in every line reflects the extent of line influence factors to object judgment, and meanwhile,  $R$  in every column reflects the extent of column influence factors to object judgment (MA *et al.*, 2012).

$$\sum_{i=1}^n r_{ij} \quad j = 1, 2, 3, \dots, m$$

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Table 2. Taiji types of sports culture inheritance evaluation indicator system.

Pay Attention to Life and Humanistic Thoughts $U_1$	Constant Virtues Moral Education $U_2$	Harmonious Social Life Philosophy $U_3$	Tough and Tenacious Cultural Characters $U_4$
Future rational life view $u_{11}$	Population education degree $u_{21}$	Harmonious phenomena ratio $u_{31}$	Youth anti-setback capacity $u_{41}$
Contemporary life values $u_{12}$	General mood of provisions for aged $u_{22}$	Reference of general mood of moderation $u_{32}$	Anti-setback capacity $u_{42}$
Contemporary life entry view $u_{13}$	Taijiquan influences scopes amount $u_{23}$	Advocate and implement harmonious society $u_{33}$	Social advocating of general mood of tough and tenacious $u_{43}$
Gender discrimination $u_{14}$		Reflection of philosophy phenomena $u_{34}$	
Humanistic thoughts impact $u_{15}$			

(4) Establishing weight sets,  $A=(a_1, a_2, \dots, a_n) \in F(U)$ , it meets the conditions:  $\sum_{i=1}^n a_i = 1 \quad a_i \geq 0$

$$B = A \cdot R$$

$$= (a_1, a_2, a_3, \dots, a_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

$$= (b_1, b_2, b_3, \dots, b_n)$$

In  $V$ , fuzzy combination is shown by evaluation set  $B$ . Based on the above described facts, the actual change model is shown in Fig. (1):

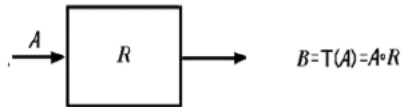


Fig. (1). Changed model.

Evaluation factors  $U_1, U_2, U_3, U_4$ , and  $U_5$  membership functions can be expressed as follows:

$$u_{v1}(u_1) = \begin{cases} 0.5(1 + \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 - \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0, & u_i < k_2 \end{cases};$$

$$u_{v2}(u_1) = \begin{cases} 0.5(1 - \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 + \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0.5(1 - \frac{u_i - k_3}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 - \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases};$$

$$u_{v1}(u_1) = \begin{cases} 0, & u_i \geq k_2 \\ 0.5(1 - \frac{k_1 - u_i}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 + \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases}$$

Establishing factor set  $U, U=(U_1 U_2 U_3 U_4)$ . Among them,  $U_1$  represents life and humanistic thoughts,  $U_2$  represents moral education,  $U_3$  represents harmonious philosophy of life, and  $U_4$  represents physical strength and tenacity as shown in Table 2.

The paper obtained the following evaluation sets.

$$U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}, u_{15}\}; U_2 = \{u_{21}, u_{22}, u_{23}\};$$

$$U_3 = \{u_{31}, u_{32}, u_{33}, u_{34}\}; U_4 = \{u_{41}, u_{42}, u_{43}\}$$

By collecting and analyzing data, important ranking statistics were obtained as shown in Table 3.

But:

$$U_1 = \{23, 7, 3, 0\}; U_2 = \{7, 18, 8, 0\}; U_3 = \{0, 9, 13, 11\};$$

$$U_4 = \{3, 0, 9, 21\}$$

Obtained weighted vector from rank 1 to rank 2 was:

$$\beta = \{\beta_1 \beta_2 \beta_3 \beta_4\} = \{0.4 \ 0.3 \ 0.2 \ 0.1\}$$

$$U_i^* = U_i \cdot \beta^T$$

$$U_1^* = 12, U_2^* = 9.8, U_3^* = 6, U_4^* = 5$$

The paper followed normalization processing:  $U_1^* = 0.35, U_2^* = 0.3, U_3^* = 0.2, U_4^* = 0.15$

$$\bar{A} = (0.35 \ 0.3 \ 0.2 \ 0.15)$$

By defining this, remarks on membership were obtained as shown in Table 4 based on the evaluation of all the factors.

**Table 3. Four kinds of factors importance degree ranking statistics.**

Classification	Rank 1	Rank 2	Rank3	Rank 4
Future population status $U_1$	23	7	3	0
Education, man-power supply $U_2$	7	18	8	0
Employment $U_3$	0	9	13	11
Provisions for the aged $U_4$	3	0	9	21

**Table 4. Remarks membership.**

Evaluation Way	Set Contribution Interval			
	0-60	60-80	80-90	90-100
Very good	0	0	0.05	0.95
Good	0	0.05	0.9	0.05
Normal	0.05	0.9	0.05	0
Poor	0.95	0.05	0	0

**Table 5. Taiji types of sports culture inheritance polices urbanization impacts evaluation value.**

Each Layer Indicator	Evaluation Value	Each Layer Indicator	Evaluation Value
Future rational life view $u_{11}$	Normal	Harmonious phenomena ratio $u_{31}$	Very good
Contemporary life values $u_{12}$	Very good	Reference of general mood of moderation $u_{32}$	Good
Contemporary life entry view $u_{13}$	Good	Advocate and implement harmonious society $u_{33}$	Good
Gender discrimination $u_{14}$	Good	Advocate and implement harmonious society $u_{34}$	Normal
Humanistic thoughts impact $u_{15}$	Normal	Youth anti-setback capacity $u_{41}$	Good
Population education degree $u_{21}$	Very good	Anti-setback capacity $u_{42}$	Good
Population education degree $u_{22}$	Good	Social advocating of general mood of tough and tenacious $u_{43}$	Normal
Population education degree $u_{23}$	Good		

Evaluating impacts of Taiji sports' cultural inheritance policies on urbanization are shown in Table 5.

From the above model, single layer indicator weight based on factor fuzzy set was obtained :

$$A_1 = \{u_{11}, u_{12}, u_{13}, u_{14}, u_{15}\} = \{0.25, 0.25, 0.2, 0.15, 0.15\}$$

$$A_2 = \{u_{21}, u_{22}, u_{23}\} = \{0.54, 0.34, 0.12\}$$

$$A_3 = \{u_{31}, u_{32}, u_{33}, u_{34}\} = \{0.4, 0.3, 0.1, 0.2\}$$

$$A_4 = \{u_{41}, u_{42}, u_{43}\} = \{0.3, 0.4, 0.3\}$$

In this research , evaluation sets related to life and humanistic thoughts, moral education, harmonious

philosophy of life and physical strength and tenacity were obtained.

Set representing life and humanistic thoughts:

$$R_1 = \begin{pmatrix} 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

$$\text{Moral education: } R_2 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

Harmonious philosophy of life:

Table 6. Taiji sports culture overseas development.

Question Designing	Answers Options	Identification			
		Coach		Students	
		Quantity	Proportion	Quantity	Proportion
Taijiquan routines	Move 1-8	12	5.5%	15	7.19%
	Move 9-16	12	5.6%	20	11.06%
	Move 17-24	27	12.3%	65	17.95%
	Move 25-32	16	6.4%	21	11.68%
	Above move 32	167	70%	158	76.89%
Basic skill movement	Single move	74	42.3%	46	25.98%
	Standing exercise	61	34.9%	85	46.51%
	Other	35	19.6%	22	18.05%
	No	6	3.56%	29	22.15%
Sports that one feels is difficult	One movement	21	11.65%	39	53.10%
	One routine	78	40.46%	95	17.16%
	Understand its cultural backgrounds	56	28.65%	30	7.58%
	Else	36	16.97%	12	25.61%
Movements that one love	Clothes	35	19.6%	38	1.18%
	Sports form	2	0.03%	3	34.98%
	Rhythm	15	8.5%	64	36.24%
	Cultural backgrounds	116	66.48%	65	8.12%
	Else	18	6.84%	14	9.68%

$$R_3 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

Tough and tenacious characters:

$$R_4 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

$$B_i = A_i \cdot R_i$$

Normalization processing with  $B_i$  gave second layer fuzzy evaluation matrix:

$$\bar{B} = \begin{pmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{pmatrix} = \begin{pmatrix} 0.065 & 0.155 & 0.367 & 0.4945 \\ 0.0057 & 0.1452 & 0.3455 & 0.5350 \\ 0.0112 & 0.2012 & 0.3845 & 0.3964 \\ 0.0356 & 0.3150 & 0.6253 & 0.0154 \end{pmatrix}$$

$$Z = \bar{A} \cdot \bar{B} = (0.0323 \quad 0.1766 \quad 0.3981 \quad 0.4166)$$

Fuzzy comprehensive evaluation model eliminates the drawbacks of traditional evaluation models. It not only simplifies calculation but also fully considers research objects based on systematic and comprehensive features. The above results indicated that the comprehensive value of Z ratio in the interval of 90-100 was larger, which suggested that the evaluation result is good.

Finally, the paper adjusted and sorted out previous evaluation on Taiji sports culture claiming that this type of sport is internationally significant and following this data, Table 6 was obtained, which also sufficiently reflects Taiji sports culture's inheritance and development.

**CONCLUSION**

By establishing attribute scale for one object, carrying out fuzzy mathematical analysis on one object, the initially analyzed object showed fuzziness or uncertain attributes. Therefore, the paper studied Chinese government's promotion policies of Taiji types of sports culture inheritance using fuzzy comprehensive evaluation method. The study also evaluated futuristic view of life, humanistic thoughts impact, implementation of harmonious society, anti-setback capacity and others multiple aspects, and concluded that China's traditional culture is of very high importance to contemporary life and social values.

**CONFLICT OF INTEREST**

The authors confirm that this article content has no conflict of interest.

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