Interaction Mechanism for the Entrepreneurship of College Students with Diversified Values

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Abstract—The negative phenomena in the society have subtle influences on the values of college students. Studying the interaction mechanism for the entrepreneurship of college students in the new era will help them establish a healthy entrepreneurial mentality. The current research focuses mainly on the development connotation and mode of the interaction mechanism for the entrepreneurship of college students, which is highly subjective and lacks empirical quantitative analysis of the interactions between multiple participants in the interaction mechanism for entrepreneurship. This paper studies the interaction mechanism for entrepreneurship of college students with diversified values. First an asymmetric game payoff matrix was established for the multiple participants including colleges, college students and cooperative enterprises in the interaction mechanism for entrepreneurship of college students, and then a replicator dynamic equation for the evolutionary game of multiple participants was solved, so as to objectively analyze the optimal behavior decisions of the multiple participants under the condition of bounded rationality. The experimental results verified the effectiveness of the constructed model.

Keywords—values, entrepreneurship of college students, interaction mechanism for entrepreneurship

1 Introduction

With the increasing diversification of the national economic structure, industry types, employment and entrepreneurial forms, and marketing and profit distribution, the values of college students who have just been employed or are in the initial stage of startups are also diversifying [1-5]. In this context, establishing correct values has become the prerequisite to the successful realization of personal values by college students through entrepreneurship [6-13]. In the new era, however diversified the college students' values might be, they should generally be positive, and those who are resilient, innovative, passionate, efficient and honest have the highest chances of

success in business startups [14-18]. However, affected by the diversification of life-styles, ideologies and cultures, there have been negative phenomena in social inter-personal interactions. For example, some people are unable to tell right from wrong or distinguish honor and disgrace, or forget honor at the sight of money or make power-for-money deals [19-24]. These negative phenomena have subtle influences over the values of college students. Therefore, it is necessary to study the interaction mecha-nism for the entrepreneurship of college students in the new era to help them establish a healthy entrepreneurial mentality.

Based on the mean-end chain model, Lin and Tu [23] conducted in-depth inter-views with students who have experience in using BSG with the soft laddering meth-od, and used the concept of "attribute-result-value" chain to understand students' value cognition structure. The results show that the ultimate value that communica-tion and continuous thinking between teams brings to users is interpersonal relation-ships and a sense of accomplishment. Bao [25] discussed the effect mechanism of Chinese traditional values in the career orientation of college students, and considered achievement motive and analyzed the relationships among the three variables - tradi-tional values, occupational orientation and achievement motive using the structural equation model. The university-industry-government triple helix constitutes a sustain-able innovation ecosystem and promotes regional development. Based on the lessons learned from project-based entrepreneurship programs with industry partners in dif-ferent contexts, Stolze et al. [26] attempted to develop a novel educational concept that deeply explores the topics entrepreneurship and digital transformation to answer the questions raised. The preliminary findings suggest that the triple-helix interactions need to co-create programs that produce value for all stakeholders, allowing the con-ceptualization of new approaches for entrepreneurial project development, which will enable technology transfer, emergence of start-ups/spin-offs and foster an entrepre-neurial mindset. Bøllingtoft [27] reported the results of an exploratory study on the entrepreneurial environment of two bottom-up business incubators, identified the networking and cooperative activities among entrepreneurs, and investigated the role of the bottom-up business incubators in the promotion and creation of entrepreneurs' internal network and cooperation conditions, thus exploring how business incubators can become a formal mechanism that embeds enterprises in entrepreneurial networks. Chen et al. [28] studied the education theories, the college education mechanism and the relationship between the talent training model and the education mechanism from the perspective of school-enterprise cooperative education mechanism. With the co-operative training cases of three Chinese universities as the data sources, it proposed a cooperative innovative and entrepreneurial talent training mechanism, which clarifies the educational goals, improves course teaching methods, adds a feedback mechanism between enterprises and universities, redefines educational evaluation methods and ensures good communications between schools, enterprises and students, thus guaran-teeing its normal operation.

Based on the existing research results, there is no doubt about the promoting role of innovation and entrepreneurship education in improving college students' entre-preneurial abilities, and coordinating and involving multiple participants in the inter-action mechanism for entrepreneurship of college students is the key to their success

of entrepreneurship. The discussions about the connotation of values and the consistency with other participants in relevant research at home and abroad have promoted the maturity and improvement of the the interaction mechanism for entrepreneurship of college students. However, the existing research is still insufficient. At the current stage, the research mainly focuses on the development connotation and mode of the interaction mechanism for entrepreneurship of college students, which is highly subjective and lacks empirical quantitative analysis of the interactions between multiple participants in the interaction mechanism for entrepreneurship. This paper studies the interaction mechanism for entrepreneurship of college students with diversified values. First an asymmetric game payoff matrix was established for the multiple participants including colleges, college students and cooperative enterprises in the interaction mechanism for entrepreneurship of college students, and then a replicator dynamic equation for the evolutionary game of multiple participants was solved, so as to objectively analyze the optimal behavior decisions of the multiple participants under the condition of bounded rationality. The experimental results verified the effectiveness of the constructed model.

2   Construction of the evolutionary game model for behaviors of colleges

The dynamic evolutionary game model can be applied to the analysis of the interactions between multiple participants in the interaction mechanism for entrepreneurship of college students, as it can provide some reference for the scientific analysis of various problems in the interaction process of college students' entrepreneurship, like unclear responsibilities, lack of entrepreneurial resources, capital risks and lack of core competitiveness. First, assumptions were put forward for the choices of the three participants involved in the interaction mechanism for entrepreneurship of college students – colleges, college students and cooperative enterprises, and an asymmetric game payoff matrix was established for the multiple participants, and then a replicator dynamic equation for the evolutionary game of multiple participants was solved, so as to objectively analyze the optimal behavior decisions of the multiple participants under the condition of bounded rationality.

Figure 1 shows a three-party game tree of the interactions in the entrepreneurship of college students, showing 8 combinations of the three parties involved, namely the college, college students and cooperative enterprises.
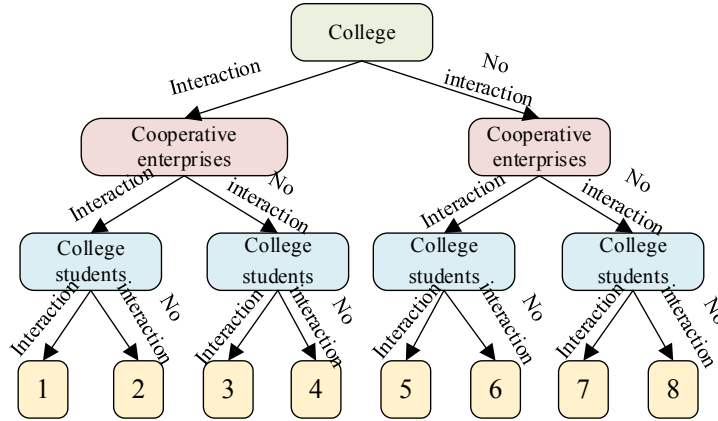
Fig. 1. Three-party game tree of the interactions in the entrepreneurship of college students

The evolutionary game payoff matrix was used to calculate the expected and average payoffs of colleges, college students and cooperative enterprises in the interaction mechanism for entrepreneurship of college students. With the evolutionary game payoff matrix about whether a college chooses to provide support for college students' entrepreneurial interactions, the expected payoffs of the college under different support decisions can be obtained, and the dynamic equation of evolutionary game for the college can be further constructed. When the college chooses to participate in college students' entrepreneurial interactions and provide support for these entrepreneurial interactions, the expected payoff V_{a1} of the college can be calculated by Equation (1):

$$V_{a1} = bc\left(P_a - O_{a1}\right) + \left(1-b\right)c\left(P_a - O_{a1} + O_{b5}\right) + \left(1-c\right)b\left(P_a - O_{a1}\right) + \left(1-c\right)\left(1-b\right)\left(P_a - O_{a1} + O_{b5}\right) \tag{1}$$

When the college chooses not to participate in college students' entrepreneurial interaction, their expected payoff V_{a2} can be calculated by Equation (2):

$$V_{a2} = bc\left(-O_{a2}\right) + \left(1-b\right)c\left(-O_{a2}\right) + \left(1-c\right)b\left(-O_{a2}\right) + \left(1-c\right)\left(1-b\right)\left(-O_{x2}\right) \tag{2}$$

From the above analysis, it can be seen that the expected payoff V_a of the college can be calculated as follows when a mixed behavior decision is made:

$$V_a = V_{a1} + V_{a2} \tag{3}$$

Based on the theory of the evolutionary game model, the following calculation can be done for the frequency of changes in the degree of participation decided by the college:

$$G\left(a\right) = \frac{da}{d\phi} = a\left(V_{a1} - V_a\right) = a\left(1-a\right)\left[P_a - O_{a1} + O_{a2} + \left(1-b\right)O_{b5}\right] \tag{4}$$

When the condition represented by Equation (5) is satisfied, $G(a)=0$.

$$b = \frac{P_a - O_{a1} + O_{a2} + O_{b5}}{O_{b5}} \tag{5}$$

In this case, whether the college chooses to participate or not in the entrepreneurial interactions of college students, their game behavior is stable and balanced, and the decisions of the college will not change easily. When the condition represented by Equation (6) is satisfied, let $G(a)=0$, and two stable equilibrium points can be obtained, namely $a=0$ and $a=1$.

$$b \neq \frac{P_a - O_{a1} + O_{a2} + O_{b5}}{O_{b5}} \tag{6}$$

In this case, when the college has already made a choice to participate or not to participate in the entrepreneurial interactions of college students, if there is no unexpected situation, the college will insist on its choice. Take the derivative of $F(x)G(a)$, and there is:

$$\frac{dG(a)}{da} = (1-2a)\left[P_a - O_{a1} + O_{a2} + (1-b)O_{b5}\right] \tag{7}$$

When the inequalities in (8) and (9) are satisfied, there is a stable equilibrium point $a=1$.

$$b > \frac{P_a - O_{a1} + O_{a2} + O_{b5}}{O_{b5}} \tag{8}$$

$$\frac{dG(a)}{da}\Big|_{a=1} < 0, \frac{dG(a)}{da}\Big|_{a=0} > 0 \tag{9}$$

In this case, the college finally decides to participate in and provide support for the entrepreneurial interactions of college students, and will resist the unexpected situation that may lead to the decision not to participate. When the inequalities in (10) and (11) are satisfied, there is a stable equilibrium point $a=0$.

$$b < \frac{P_a - O_{a1} + O_{a2} + O_{b5}}{O_{b5}} \tag{10}$$

$$\frac{dG(a)}{da}\Big|_{a=1} > 0, \frac{dG(a)}{da}\Big|_{a=0} < 0 \tag{11}$$

In this case, the college finally decides to remain silent, that is, not to participate in the entrepreneurial interactions of college students, and to resist the unexpected situation that may lead to the decision to participate. Based on the above analysis, the

replicator dynamic phase diagram of the evolutionary game process for the college can be drawn.

3 Construction of the evolutionary game model for behaviors of cooperative enterprises

With the evolutionary game payoff matrix about whether a prospective cooperative enterprise chooses to participate in college students' entrepreneurial interactions and achieve cooperation, the expected payoff of the enterprise under different decisions can be obtained, and the dynamic equation of evolutionary game for the enterprise can be further constructed. When the prospective cooperative enterprise chooses to participate in college students' entrepreneurial interactions and provide cooperation, the expected payoff V_{b1} of the enterprise can be calculated by Equation (1):

$$
\begin{aligned}
V_{b1} = {} & ac\left(S_{b1} + S_{b2} - O_{b1}\right) + a\left(1 - c\right)\left(S_{b2} - O_{b1}\right) \\
& + \left(1 - a\right)b\left(S_{b1} + S_{b2} - O_{b1}\right) + \left(1 - a\right)\left(1 - c\right)\left(S_{b2} - O_{b1}\right)
\end{aligned}
\tag{12}
$$

When the prospective cooperative enterprise chooses not to participate in college students' entrepreneurial interaction, their expected payoff V_{b2} can be calculated as follows:

$$
\begin{aligned}
V_{b2} = {} & ac\left(S_{b1} - O_{b2} - O_{b3} - O_{b4} - O_{b5}\right) + \\
& \left(1 - c\right)a\left(-O_{b2} - O_{b3} - O_{b5}\right) + \left(1 - a\right)c\left(S_{b1} - O_{b2} - O_{b3} - O_{b4}\right) \\
& + \left(1 - a\right)\left(1 - c\right)\left(O_{b2} - O_{b3}\right)
\end{aligned}
\tag{13}
$$

Based on Equations (12) and (13), Equation (14) shows the calculation formula of the expected payoff V_b of the prospective cooperative enterprise when it adopts a mixed decision:

$$
V_b = V_{b1} + V_{b2}
\tag{14}
$$

Based on the principle of evolutionary game, Equation (15) gives the calculation formula of the frequency of changes in whether the enterprise decides to participate in college students' entrepreneurial interactions:

$$
G\left(b\right) = \frac{dc}{d\phi} = b\left(V_{b1} - V_b\right) = b\left(1 - b\right)\left[S_{b2} - O_{b1} + O_{b2} + O_{b3} + aO_{b5} + cO_{b4}\right]
\tag{15}
$$

Take the derivative of $G(b)$, and there is:

$$
\frac{dG\left(b\right)}{db} = \left(1 - 2b\right)\left[S_{b2} - O_{b1} + O_{b2} + O_{b3} + aO_{b5} + cO_{b4}\right]
\tag{16}
$$

When the inequalities in (17) and (18) are satisfied, there is a stable equilibrium point a=1.

$$a > \frac{O_{b1} - O_{b2} - O_{b3} - S_{b2} - cO_{b4}}{O_{b5}} \tag{17}$$

$$\frac{dG(b)}{db}\Big|_{b=1} < 0, \frac{dG(b)}{db}\Big|_{b=0} > 0 \tag{18}$$

In this case, the prospective cooperative enterprise decides to participate in college students' entrepreneurial interactions and provide cooperation, and it will resist any unexpected situation that may lead to its non-participation. When the inequalities in (19) and (20) are satisfied, there is a stable equilibrium point a=0.

$$a < \frac{O_{b1} - O_{b2} - O_{b3} - S_{b2} - cO_{b4}}{O_{b5}} \tag{19}$$

$$\frac{dG(b)}{db}\Big|_{b=1} > 0, \frac{dG(b)}{db}\Big|_{b=0} < 0 \tag{20}$$

In this case, the prospective cooperative enterprise finally decides not to participate in college students' entrepreneurial interactions and will resist any unexpected situation that may lead to its decision to participate.

4 Construction of the evolutionary game model for behaviors of college students considering the influences of values

Under the negative effects of multicultural influence, Internet finance, and fast-paced market economy, the existing innovation and entrepreneurship education is insufficient to exert positive influences on college students' entrepreneurial values, and some ideological problems of college students like utilitarianism, selfishness and hedonism in their entrepreneurship are not effectively corrected. Figure 2 builds a model of the influencing factors to college students' diversified values. This paper conducted relevant analysis from three perspectives - environment, education and college students' values. Environmental factors include entrepreneurship policy environment, industry and market environment, legal environment, cultural environment and financial environment; educational factors include penetrating entrepreneurship education, universal entrepreneurship education, focused entrepreneurship education, and specialized entrepreneurship education; and values of college students include professional values, personal values and entrepreneurial goals.
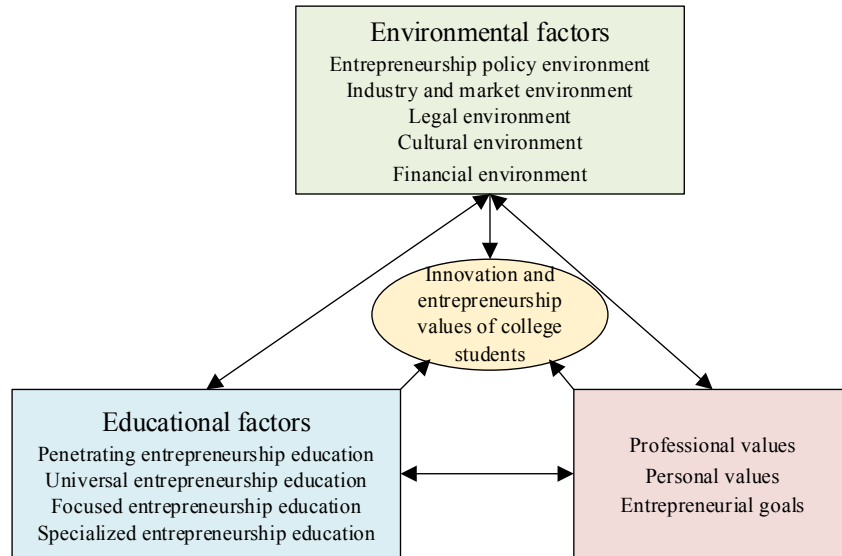
Fig. 2. Model of influencing factors to college students' diversified values

College students' entrepreneurial values represent the goals pursued by college students in the process of their entrepreneurial practice and interactions with other participants. The goal of improving innovation and entrepreneurship values should be to achieve consistency between personal values of college students and social values. Therefore, the positive influences of college students' entrepreneurial values on their entrepreneurial interactions can be analyzed from three perspectives - entrepreneurial value goals, entrepreneurial value evaluation and entrepreneurial value choices. Entrepreneurial value goals are the social and personal value goals of college students in their entrepreneurship; evaluation of entrepreneurial values includes evaluation of entrepreneurial success factors, self-recognition and evaluation of entrepreneurial competence, evaluation of entrepreneurial education satisfaction, and evaluation of entrepreneurial intentions; and the choices of entrepreneurial values includes career choice and choice of justice and benefit.

When a college student under the positive influence of values chooses to participate in entrepreneurial interactions to seek resources and opportunities, his expected payoff V_{c1} can be calculated by Equation (21):

$$
\begin{aligned}
V_{c1} = & ba(T_{c1} + S_{b1}) + (1-b)a(T_{c2} - S_{b1} + O_{b4}) \\
& + (1-a)b(T_{c1} + S_{b1}) + (1-a)(1-b)(T_{c2} - S_{b1} + O_{b4})
\end{aligned}
\tag{21}
$$

When a college student under the negative influence of values chooses not to participate in entrepreneurial interactions, his expected payoff V_{c2} can be calculated by Equation (22):

$$V_{c2} = 0 \tag{22}$$

Based on Equations (21) and (22), the expected payoff V_c of the college student can be calculated by Equation (23) when he adopts a mixed decision:

$$V_c = V_{c1} + V_{c2} \tag{23}$$

Based on the principle of evolutionary game, the frequency of changes in the college student's decision to participate or not to participate in entrepreneurial interactions under the influence of diversified values can be calculated based on the following equation:

$$G(b) = \frac{dc}{d\phi} = c(V_{c1} - V_c) = c(1-c)\left[b(T_{c1} - T_{c2} - O_{b4}) + T_{c2} - S_{b1} + O_{b4}\right] \tag{24}$$

When the inequalities in (25) and (26) are satisfied, there is a stable equilibrium point $c=1$.

$$b > \frac{S_{b1} - T_{c2} - O_{b4}}{T_{c1} - T_{c2} - O_{b4}} \tag{25}$$

$$\frac{dG(c)}{dc}\Big|_{c=1} < 0, \frac{dG(c)}{dc}\Big|_{c=0} > 0 \tag{26}$$

In this case, the college student finally decides to participate in entrepreneurial interactions to seek resources and opportunities, and will resist any unexpected situation that may lead to its decision not to participate. When the inequalities in (27) and (28) are satisfied, there is a stable equilibrium point $c=0$.

$$b < \frac{S_{b1} - T_{c2} - O_{b4}}{T_{c1} - T_{c2} - O_{b4}} \tag{27}$$

$$\frac{dG(c)}{dc}\Big|_{c=1} > 0, \frac{dG(c)}{dc}\Big|_{c=0} < 0 \tag{28}$$

In this case, the college students finally decide not to participate in entrepreneurial interactions, that is, he will not accept the resources and opportunities offered by other participants in the interaction mechanism for his entrepreneurship, and will resist any unexpected situation that may lead to its decision to participate. Based on the above analysis, the replicator dynamic equation for the evolutionary game of multiple participants in the interaction mechanism for entrepreneurship of college students under the influence of diversified values is expressed as follows:

$$\begin{cases} G(a) = \dfrac{da}{d\phi} = a(V_{a1} - V_a) = a(1-a)\left[P_a - O_{a1} + O_{a2} + (1-b)O_{b5}\right] \\[3mm] G(b) = \dfrac{db}{d\phi} = b(V_{b1} - V_b) = b(1-b)\left[S_{b2} - O_{b1} + O_{b2} + O_{b3} + aO_{b5} + cO_{b4}\right] \\[3mm] G(c) = \dfrac{dc}{d\phi} = c(V_{c1} - V_c) = c(1-c)\left[b(T_{c1} - T_{c2} - O_{b4}) + T_{c2} - S_{b1} + O_{b4}\right] \end{cases} \quad (29)$$

5   Experimental results and analysis

This paper analyzed the reasons why college students participate in entrepreneurial interactions, with the statistical results shown in Figure 3. It can be seen that the top three reasons are "obtaining more interpersonal resources" (68%), "seeking more development opportunities" (55%) and "improving market sensitivity" (53%)", followed by "learning social skills" (48%) and "improving the entrepreneurial organizational structure" (38%). Through the survey of the value goals of college students participating in entrepreneurial interactions shown in Figure 4, it was found that the top three value goals chosen by college students were "realizing personal values" (45.24%), "making career achievements" (28.93%), and "obtaining pecuniary interest" (14.21%), and that the remaining two were "fighting for freedom in work" (8.1%) and "fulfilling social responsibilities" (3.52%).
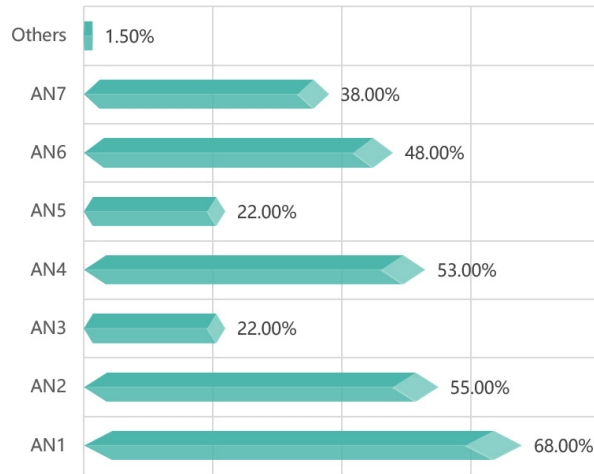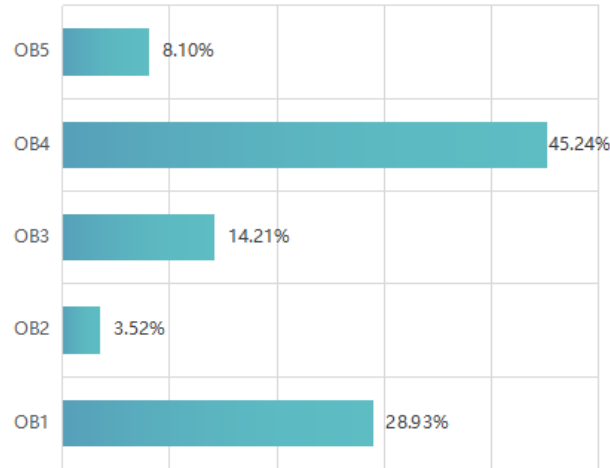

Fig. 3. Reasons for college students' participation in entrepreneurship Interactions

Fig. 4. Value goals of college students in participation in entrepreneurial interactions

Table 1 shows the differences between male and female students in the value goals of "innovation and entrepreneurship". It can be seen that for college students of both genders, "realization of personal value" and "fighting for freedom in work" are the top two. The only difference is that male students pay more attention to "realizing personal values", while female ones, "fighting for freedom in work".

Table 1. Differences between male and female students in the value goals of innovation and entrepreneurship

|		Realizing personal values	Making career achievements	Obtaining pecuniary interest	Fighting for freedom in work	Fulfilling social responsibilities
Male	Persons	582	83	261	584	139
	Proportion	35.8%	5.2%	16.7%	39.1%	7.4%
Female	Persons	728	85	314	1328	185
	Proportion	26.3%	3.8%	13.7%	48.6%	7.5%

Figure 5 shows the evolutionary trends of the three parties' willingness to participate in the interactions. It can be seen that under the conditional probability of 0.5 in decision making, the results of all the three parties eventually converged to 1. It can also be seen that within one cycle, the evolution path of college students' willingness to participate in entrepreneurial interactions showed a downward trend, which means, the college students' willingness to participate in entrepreneurial interactions tended to be low at this time. After more than one cycle, the evolution path showed a significant upward trend and converged to 1, indicating that when college students truly perceived the benefits of entrepreneurial interactions, their traditional values and entrepreneurial ideas changed and they were more willing to try to participate in the entrepreneurial interaction process, and finally the path reached a stable equilibrium

state after 6 cycles. Similarly, the evolutionary paths of the college and the cooperative enterprise rose rapidly at first, and then gradually converged to 1 after more than 2 cycle, approaching a stable equilibrium state. However, the difference between the two is that the growth of the path of the cooperative enterprise in the early stage was slightly faster than that of the college, indicating that with the entrepreneurial time of college students going, the cooperative enterprise contributed more to the entrepreneurial success of college students. As the leading role in college students' entrepreneurial interactions and coordination, the college was ultimately in a stable and balanced state with its active participation and support.
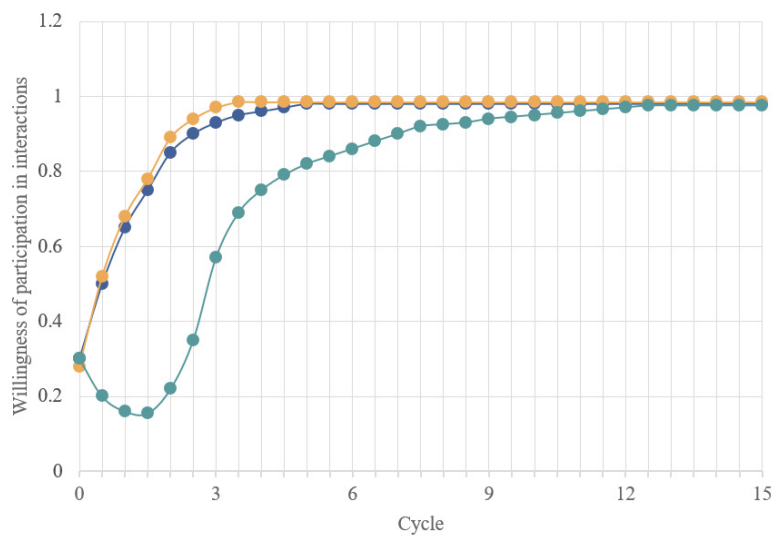
Fig. 5. Evolutionary trends of the three parties' willingness of participation in interactions

Figure 6 shows the evolutionary paths of the cooperative enterprise's willingness to participate in interactions under the influence of the willingness of participation of college students with diversified values, if the probability is fixed for the cooperative enterprise's willingness to participate in students' entrepreneurial interactions, while the probabilities for the willingness of the college and students change. It can be seen that in the initial stage of the evolution cycles, as students are not influenced by the subjective values and the objective environment and also educational factors, they do not quite recognize the importance of participation in entrepreneurial interactions, and their willingness to participate in entrepreneurial interactions tends to decline. Under this circumstance, if the cooperative enterprise shows a good cooperative prospect to the college students with a positive attitude, the college students will gradually change their willingness to participate in the interactions, and at the same time, the relevant college organizations will be much more active.
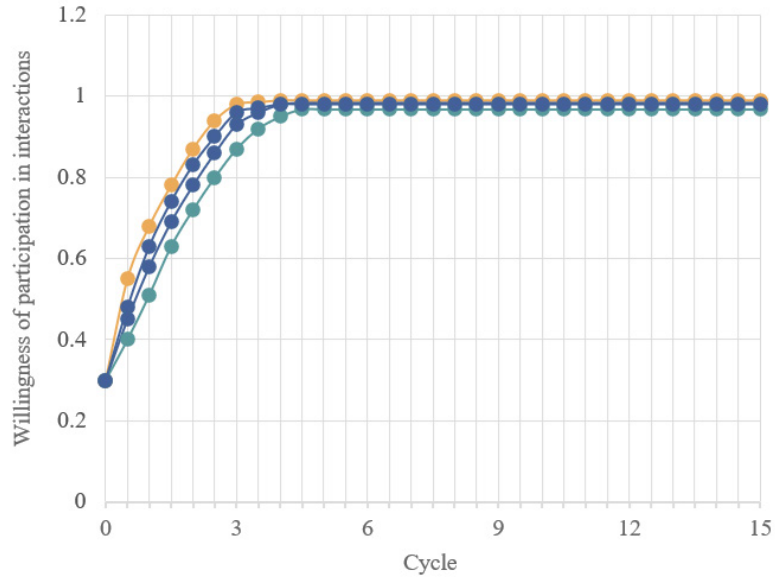
Fig. 6. Evolutionary paths of the cooperative enterprise's willingness of participation in interactions

Figure 7 shows the evolutionary paths of college students' willingness to participate in interactions under the influence of different values if the probability is fixed for college students' willingness to participate in entrepreneurial interactions while those change for the willingness of the college and the cooperative enterprise. It can be seen that in the initial stage of the evolution cycles, college students' willingness to participate in entrepreneurial interactions shows a steady upward trend, and that after more than 10 cycles, it reaches the regional stable equilibrium state. Any initial probability of willingness of the college and the cooperative enterprise to participate will make the final decision of college students to participate converge to a steady state. It shows that the positive attitudes of the college and the cooperative enterprise will change the entrepreneurial attitude of college students. The clear positioning of cooperative enterprises has a great impact on the evolutionary strategy for college students' decision on participation in interactions, and can effectively promote the expansion of entrepreneurial resources for college students.
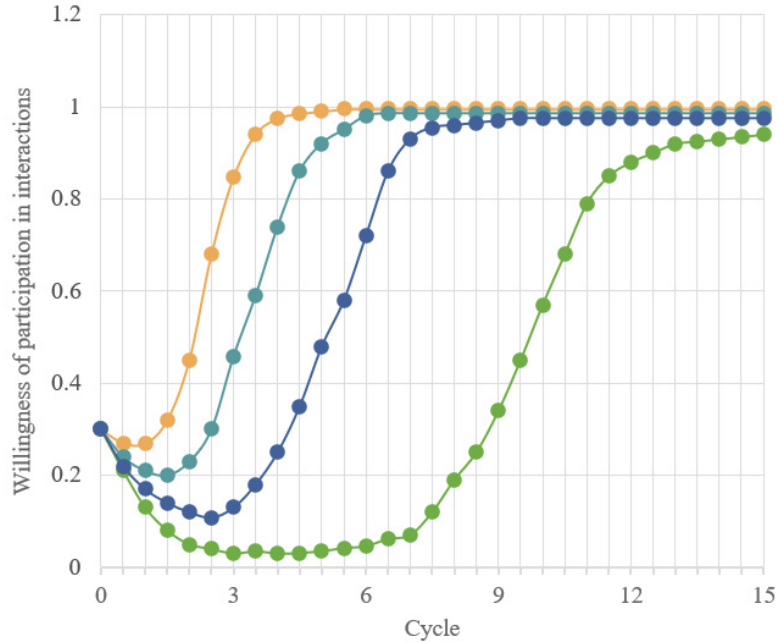
Fig. 7. Evolutionary paths of the college students' willingness of participation in interactions

6 Conclusions

This paper studied the interaction mechanism for entrepreneurship of college students with diversified values. First, an asymmetric game payoff matrix was established for the multiple participants including colleges, college students and cooperative enterprises in the interaction mechanism for entrepreneurship of college students, and then a replicator dynamic equation for the evolutionary game of multiple participants was solved, so as to objectively analyze the optimal behavior decisions of the multiple participants under the condition of bounded rationality. Per the analysis on the reasons for college students' participation in entrepreneurial interactions, the top three reasons were "obtaining more interpersonal resources" (68%), "seeking more development opportunities" (55%) and "improving market sensitivity" (53%)". Per the survey on the value goals of college students participating in entrepreneurial interactions, the top three value goals chosen by college students were "realizing personal values" (45.24%), "making career achievements" (28.93%), and "obtaining pecuniary interest" (14.21%). After that, the evolutionary paths of the three parties' willingness to participate in interactions were drawn, and the relevant analysis results were given.

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