Research on innovation management of science and technology innovation team members based on constructive conflict evolution game

Tao Wan,[1] Qi Wang ,[1] Ketong Xu,[1] Jiaqi Zhao,[1] Hiroshi Otsuki[2]

[1]College of Economics and Management, Xi'an Technological University, Xi'an, Shannxi, China
[2]School of Commerce, Waseda University, Shinjuku-ku, Tokyo, Japan

Correspondence to
Mr Qi Wang, College of Economics and Management, Xi'an Technological University, Xi'an 710032, China; m1905210435@163.com

Accepted 5 March 2021
Published Online First 14 May 2021

ABSTRACT

How to give full play to the positive function of constructive conflicts (task conflicts and process conflicts) in the science and technology innovation team, give appropriate stimulation, mobilize the enthusiasm of employees and improve the team's innovative ability to improve team performance and organizational effectiveness are issues that deserve both team leaders' and scholars' attention. Through selecting multiple medical technology R&D personnel from a specific science and technology innovation team of health organization, the research studies the constructive conflicts among the members of the science and technology innovation team, constructs and analyzes the conflict evolution game model, proposes countermeasures and suggestions for improving the innovation ability of the science and technology innovation team and discusses the innovation management mechanism of the science and technology innovation team. The study shows that task conflicts, process conflicts and innovation game decisions cannot be avoided. The unstable choice of members does not promote innovation. However, on the one hand, constructive conflicts can be controlled to maintain a moderate state of control. On the other hand, it is also necessary to establish a mutually trusting communication environment and convenient communication channels in the science and technology innovation team, combined with modern information management technology, to handle the problems that were difficult to be found or accumulated for a long time under the previous management mechanism and cooperate with the science and technology innovation team to improve the technology innovation team's innovation capability.

Significance of this study

What is already known about this subject?

- Proper team conflicts can enhance the team's ability to innovate.
- Conflict can make the team fruitful and more flexible in completing tasks.
- The active role of team conflicts can effectively advance the technological innovation of enterprises and team managers must fully understand the significance and impact of constructive conflicts.

What are the new findings?

- Conflict games can well grasp the quantity and degree of conflicts.
- Constructive conflicts can be effectively controlled to maintain a moderate state of control.
- A mutually trusting communication environment and convenient communication channels in the science and technology innovation team is necessary.

How might these results change the focus of research or clinical practice?

- It is necessary to establish a mutually trusting communication environment and convenient communication channels in the clinical science and technology innovation team, combined with modern clinical information management technology, to handle the problems that were difficult to be found or accumulated for a long time under the previous management mechanism and cooperate with the clinical science and technology innovation team to improve the clinical technology innovation team's innovation capability.

INTRODUCTION

Excessive team spirit, lacking of constructive conflict, could limit science and technology innovation team member's willingness to challenge diversified perspectives seriously.[1] How to give full play to the positive function of constructive conflicts (task conflicts and process conflicts) in the science and technology innovation team, give appropriate stimulus, encourage different opinions, mobilize the enthusiasm of employees and advance the team's innovative ability to improve team performance and organizational effectiveness are worthy of scholars' attention.[2 3] Proper team conflicts can enhance the team's ability to innovate.[4] The issues of conflict management, organizational innovation and adopted related organizational management research methods to conclude that cooperative conflict management can promote fruitful conflicts, improve the effectiveness of high-level management teams and effectively

To cite: Wan T, Wang Q, Xu K, *et al*. *J Investig Med* 2021;**69**:1245–1252.

lead to organizational innovation.[5] Conflict can make the team fruitful and more flexible in completing tasks. By training a small number of different opinions in the team, the team can be more efficient and innovative.[6] The active role of team conflicts can effectively advance the technological innovation of enterprises and team managers must fully understand the significance and impact of constructive conflicts.[7] Existing research found that constructive conflict can contribute to the success of organizations and open-minded discussion is essential for constructive conflict.[8] In addition, some scholars analyzed the relationship between conflict management and task introspection by constructing the Team Conflict Dynamics Model.[9] After extensive investigation, empirical conclusions supported that constructive conflict can help the team introspect task and increase team effectiveness.[10] Some researchers used the method of conflict game and the construction of a game model about process conflicts to analyze from the perspective of the benefits of both parties to the game, effectively control the vicious process conflicts, promote constructive conflicts and enable team members to maintain positive conflict and profit teamwork development.[11] Therefore, it is necessary to study constructive conflicts by using game methods. Game theory is a set of model tools designed to express and analyze such strategic interactions.[12] Under the constructive conflict mechanism, relevant research adopt game theory to meet the basic conditions for maintaining innovation within the members of the science and technology innovation team, promoting the leadership of the science and technology innovation team to improve the team's innovation ability.

Existing research believes when there is a cooperative goal relationship between people, conflicts will also occur in the interaction. The conflicts, between the parties in different ways, in order to achieve the common goal, are called "Constructive Conflicts".[13] Teams with different views on the task or its solutions are more creative than teams with identical views among all members.[14] People have realized the necessity of constructive conflict.[15] Constructive conflict can improve the efficiency and vitality of the organization. On the one hand, it is easy to cause inefficient decision-making and management when organization does not have conflict or only have few conflicts. On the other hand, the duality of conflicts shows that many constructive conflicts will bring or transform into destructive conflicts. The innovation and career development of any organization requires a suitable innovation ecosystem and one of the cultural elements of this innovation ecosystem is an organizational culture that encourages constructive conflict.[16] The lack of critical thinking and discouraging constructive conflicts will form a culture of indecision. Building commitments and promoting implementation that require constructive conflicts is a key leadership principle. The conflicting state of behavior decision-making, psychological opposition or contradiction arising from the different approaches of different subjects to the treatment of specific objects in a conflict is also a game process.[11] Therefore, game is the best way to resolve conflicts. For example, some researchers constructed a static game model of incomplete information based on the assumption of completely rational brokers.[17] In this article, the players are team members: "A" and "B". The strategic choices that members can adopt are cooperation or betrayal. Under calculation and analysis, for resolving team conflicts, it is necessary to reduce the lost gains by the other party's betrayal, increase the benefits of the cooperation between the two parties and reduce the benefits of the two parties' choice to betray. Moreover, some scholars used traditional game theory method to build a model about team emotional conflict, cognitive conflict and their relationship for coming up with a strategy choice for conflict resolution in cooperation.[18] In this study, the game party includes team members: "A" and "B"; under an infinite number of repeated game analysis, researchers find out: under the assumption of strong correlation of emotional conflict and cognitive conflict, if the benefit of caring for emotions is greater than the benefit of not supporting cognition, the strong correlation of emotional conflict and cognitive conflict is beneficial to the team and individuals. But if the benefit of caring for emotions is not greater than the benefit of not supporting cognition, the strong relationship between emotional conflict and cognitive conflict causes no effect on the entire team and losses to team members. Some researchers constructed the relational conflict game model of strategic network and proposes the resolution strategy for relational conflict.[19] Besides, some researchers used integrated mutation theory and evolutionary game to build an evolutionary model of employee conflict mutation behavior.[20] The model can explain the changing process of employee conflict behavior under the influence of two types of dependent variables: "Interest" and "Emotion"[21] . Then, on the one hand, combined with evolutionary game theory, the evolutionary rules of conflict decision between organizations and employees, including the development characteristics of conflict situations, were discussed. On the other hand, conflict management strategies and measures were proposed. The science and technology innovation team is a collection of people with professional skills in related disciplines.[18] The members in this collection can or have achieved some accomplishments and achievements in the subject areas they are good at. With the development of science and technology cooperation, team management also needs to keep up with the pace of development and cooperation. At the same time of development, various conflicts in different forms will break out within the team. Teams can use conflict game methods to promote team management. Many Scholars have researched on team conflicts, process conflicts and relational conflicts based on team leader, power distance and geographical distribution of team members and so on.[22–31] But there are few studies on the relationship between two types of conflicts,[32] particularly on the research about constructive conflicts.[17] Therefore, the study found that there are still many things that can be explored and improved by using game theory to study team constructive conflicts, especially the conflicting role between task and process game on the innovation effect of science and technology innovation teams.

Previous studies have shown that constructive conflicts often include task conflicts and process conflicts.[33] Task conflict refers to the conflict caused by the inconsistent views of team members on the task content and process conflict refers to that caused by the inconsistency of team members in the procedures and methods for completing the task.[34] The following is a game analysis of task and process conflicts by using the evolutionary game model to establish

the organic relationship between constructive conflicts and team innovation. Traditional game theory has stricter rational assumptions for game players that require players to be completely rational, always based on their own maximum return as the basis for strategy selection, and will never make mistakes in understanding things accurately. Obviously, these assumptions are somewhat deviating from reality. Conversely, the evolutionary game theory is based on the assumption of bounded rationality, introduces the dynamic process of time and the method of team members' learning ability, which is closer to reality and conforms to the actual situation. When a constructive conflict occurs in the science and technology innovation team, how the members of the team will make choices to promote innovation of the members of the science and technology innovation team can be analyzed and studied by using the evolutionary game method.

MATERIALS AND METHODS

Research statement

Under the premise of following the academic ethics and ethics requirements, this study was approved by the Academic Committee of the School of Economics and Management of Xi'an Technological University and the Graduate School of Xi'an Technological University (ID:X-AGDYJ200211), and selected multiple medical technology R&D personnel from the science and technology innovation team of Xi'an International Medical Investment Co., Ltd. For mathematical analysis, relevant research data were collected and organized by graduate students of the School of Economics and Management of Xi'an Technological University.

Task conflict game model hypothesis and model analysis

Game model assumptions

1. Members 1 and 2 of the science and technology innovation team are the main players of the bounded rational game with the cognition and understanding of differences in scientific research tasks.
2. The strategy set of team member 1 and member 2 in the scientific research process is {Innovation, Task Conflict}. Under the "Innovation" strategy, team members are willing to put aside conflicts and work together to innovate for scientific research goals. At this time, on the one hand, the science and technology innovation team has high innovation performance and high organizational cohesion. The "Task Conflict" strategy shows that both team members are unwilling to let go of the conflicts. Everyone holds their own opinions and disagrees with each other's opinions. On the other hand, the team's scientific research tasks are difficult to carry out, the innovation ability is difficult to stimulate and the task conflicts become vicious conflicts.
3. $\Delta R1$ and $\Delta R2$ ($\Delta R1 \neq \Delta R2$, $\Delta R1>0$ and $\Delta R2>0$) are the additional benefits or rewards of the members of the science and technology innovation team member 1 and 2 still choose the "Innovation" strategy when the task conflict occurs and the task conflict is a vicious conflict. $R1$ and $R2$ ($R1 \neq R2$, $R1>0$ and $R2>0$) are the benefits when the science and technology innovation team members 1 and 2 choose the "Task Conflict" strategy. G ($G>0$) is the fine of the members of the science and technology innovation team when team members choose the "Task Conflict" strategy. Then, $k1$ and $k2$ are the penalty coefficients when member 1 and member 2 receive the penalty. $C1$ and $C2$ ($C1 \neq C2$, $C1>0$ and $C2>0$) are the losses suffered by the party who chooses "Innovation" strategy when one party chooses "Task Conflict" strategy.
4. Assuming that the proportion of "Innovation" strategy of member 1 is m ($m \in [0,1]$) and the proportion of "Task Conflict" is $(1-m)$. Similarly, the proportion of member 2 adopting "Innovation" strategy is n ($n \in [0,1]$) and the proportion of member 2 adopting "Task Conflict" is $(1-n)$.

Based on the above assumptions, the available task conflict game matrix between members 1 and 2 of the science and technology innovation team is shown in table 1.

Game model analysis

According to the above conflict game payment matrix (table 1), assuming that member 1 chooses the "Innovation" strategy, the expected return is $U1P$, so

(1) $U1P=n\Delta R1-(1-n)C1$

If the expected benefit of choosing the "Task Conflict" strategy is $U1q$, so

(2) $U1q=n(R1-k1G)+(1-n)(R1-k1G)$

The average expected return of the two strategies is $U1=mU1P+(1-m)U1q$.

Substituting equation (1) and equation (2) into, hence

(3) $U1=m[n\Delta R1-(1-n)C1]+(1-m)[n(R1-k1G)+(1-n)(R1-k1G)]$

The replication dynamic equation of member 1 is $dm/dt=m(U1P-U1)$.

Substituting formula (1) and formula (3) into

(4) $dm/dt=m(1-m)[n\Delta R1-(1-n)C1-R1+k1G]$

Similarly, assuming that the expected return of member 2 who chooses the "Innovation" strategy is $U2p$, so

(5) $U2p=m\Delta R2-(1-m)C2$

Choosing the "Conflict" strategy's expected return is $U2q$, so

(6) $U2q=m(R1-k1G)+(1-m)(R2-k2G)$

The average expected return of member 2 is

(7) $U2=n[m\Delta R2-(1-m)C2]+(1-n)[m(R1-k1G)+(1-m)(R2-k2G)]$

The replication dynamic equation of member 2 is

(8) $dn/dt=n(U2p-U2)=n(1-n)[m\Delta R2-(1-m)C2-R2+k2G]$

Finally, getting the five balance points of the conflict dynamic game between member 1 and member 2 of the science and technology innovation team: $O(0,0)$, $A(0,1)$, $B(1,1)$, $C(1,0)$, $D[(R2-k2G+C2)/(\Delta R2+C2), (R1-k1G+C1)/(\Delta R1+C1)]$.

Table 1 Evolutionary game matrix of task conflict evolution of asymmetric members of the science and technology innovation team

		Member 2	
Member 1	Innovation n		Task conflict $(1-n)$
	Innovation m	$\Delta R_1, \Delta R_2$	$-C_1, R_2-k_2G$
	Task conflict $(1-m)$	$R_1-k_1G, -C_2$	R_1-k_1G, R_2-k_2G

Evolutionary stability analysis of member 1's strategy

Let $F'(M)=dm/dt$. A stable state, called an evolutionary stability strategy, must be robust to small disturbances. According to the stability theorem of differential equations and the nature of evolutionary stability strategies, when $F'(M^*)<0$, $(1-2m)$ $[n\Delta R1-(1-n)C1-R1+k1G]<0$, M^* is an evolutionary stability strategy. When $n=[(R1-k1G+C1)/(\Delta R1+C1)]$, $dm/dt=0$, any m is stable state.

When $n>[(R1-k1G+C1)/(\Delta R1+C1)]$, $F'(1)<0$, $m^*=1$ is the evolutionary stability strategy. The result of the game is: when $n>n^*$, $U1P>U1q$, the benefit of member 1 choosing "Innovation" strategy is greater than the benefit of choosing "Task Conflict" strategy. And the probability of member 2 choosing "Innovation" strategy is greater than a constant value, member 1 will still choose "Innovation" strategy.

When $n<[(R1-k1G+C1)/(\Delta R1+C1)]$, $F'(0)<0$, $m^*=0$ is an evolutionary stability strategy. The result of the game is: when $n<n^*$, $U1p<U1q$, the benefit of member 1 choosing "Innovation" strategy is less than the benefit of choosing "Task Conflict" strategy. And the probability of member 2 choosing "Innovation" strategy is less than a constant value, member 1 will eventually choose "Task Conflict" strategy.

Evolutionary stability analysis of member 2's strategy

Similarly, let $F'(N)=dn/dt$. When $F'(N^*)<0$, N^* is an evolutionary stability strategy. If $m=[(R2-k2G+C2)/(\Delta R2+C2)]$, $dn/dt=0$, any n is stable state.

When $m>[(R2-k2G+C2)/(\Delta R2+C2)]$, $F'(1)<0$, $n^*=1$ is the evolutionary stability strategy. The result of the game is: when $m>m^*$, $U2P>U2$ q, the benefit of member 2 choosing "Innovation" strategy is greater than the benefit of choosing "Task Conflict" strategy. And the probability of team member 2 choosing "Innovation" strategy is greater than a certain value, member 2 will eventually choose "Innovation" strategy.

When $m<[(R2-k2G+C2)/(\Delta R2+C2)]$, $F'(0)<0$, $n^*=0$ is the evolutionary stability strategy. The result of the game is: when $m<m^*$, $U2P<U2q$, the benefit of member 2 choosing "Innovation" strategy is less than the benefit of choosing "Task Conflict" strategy. And the probability of team member 1 choosing "Innovation" strategy is less than a certain value, member 2 will eventually choose "Task Conflict" strategy.

To sum up, the strategy dynamic evolution graph of member 1 and member 2 is shown in figure 1.

The effect of task conflict on team performance demands a consideration of conflict degree.[35] It can be seen from figure 1 that A is a saddle point, B is the starting point of instability, C is a saddle point and O is an evolutionary stable state. When $C1$ or $C2$ of choosing "Innovation" strategy and $R2$ or $R2$ of choosing "Task Conflict" strategy remain unchanged, the smaller the penalty G for choosing "Task Conflict" strategy and the gain of jointly choosing "Innovation" strategy, the smaller the $\Delta R1$ or $\Delta R2$, the greater the m^* and n^*, the greater the probability of choosing "Task Conflict" strategy. When the net benefit of choosing "Task Conflict" strategy is smaller than the benefit of choosing "Innovation" strategy, members will eventually choose "Task Conflict" strategy. Therefore, team leaders, for improving team members' innovation and increasing team innovation performance, can increase the punishment

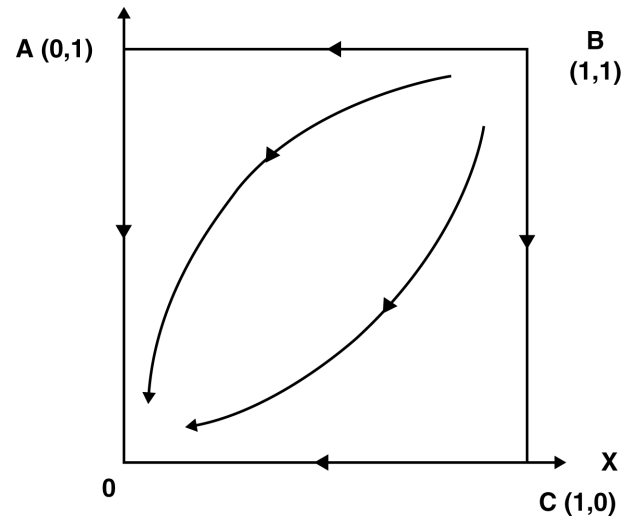

Figure 1 Dynamic evolution diagram in task conflict game model.

G for choosing "Task Conflict" strategy and $\Delta R1$ or $\Delta R2$ of choosing "Innovation" strategy to encourage irrational members to choose "Innovation" strategy.

Process conflict game model assumption and analysis

Game model assumptions

1. Members 1 and 2 of the science and technology innovation team are the main players of the bounded rational game with different methods and processes for completing scientific research tasks.
2. The strategy set of team members 1 and 2 in the scientific research process is {Innovation, Process Conflict}. Under the "Innovation" strategy, both parties are innovating and the conflict between the two parties is within the controllable range. Everyone is working together to create the greatest benefits for the team. But under the "Process Conflict" strategy, the innovation of both parties is blocked, the working enthusiasm of each member is low, the satisfaction is not high and the team's vitality is low. At this time, the conflict is in an uncontrollable range and the process conflict becomes a vicious conflict.
3. $R1$ and $R2$ ($R1\neq R2$, $R1>0$ and $R2>0$) are expressed as the benefits obtained by team member 1 and 2 when the process conflict occurs and it manifests as a vicious conflict. ΔR ($\Delta R>0$) is the additional benefits or rewards (such as team rewards) obtained by member 2 on the basis of scientific research work due to innovation in the scientific research process. β ($0\leq\beta\leq1$) is the distribution coefficient of excess returns between member 1 and member 2. R ($R>0$) is the additional income of one party that is based on the selection of "Innovation" strategy when "Process Conflict" strategy is selected by other party (such as independent research and development after obtaining innovation points). C ($C>0$) is the fine of "Process Conflict" strategy adopted by the members of the science and technology innovation team (passive slacking and other behaviors are punished). δ is the loss suffered by member 1 or member 2 adopting the innovation strategy alone.

4. Assuming that the proportion of "Innovation" strategy of member 1 is x ($x\in[0,1]$) and the proportion of "Process Conflict" strategy is $(1-x)$. Similarly, the proportion of member 2 adopting "Innovation" strategy is y ($y\in[0,1]$) and the proportion of member 2 adopting "Process Conflict" strategy is $(1-y)$.

Based on the above assumptions, the conflict game payment matrix between member 1 and member 2 is obtained as shown in table 2.

Game model analysis

According to the above conflict game payment matrix (table 2), assuming that member 1 chooses the "Innovation" strategy and the expected return is $U1P$, so

(1) $U1P=y(R1+\beta\Delta R)+(1-y)(R1-\delta)$

If the expected return of the "Process Conflict" strategy is $U1q$, so

(2) $U1q=y(R1+RC)+(1-y)R1$

The average expected return of the "Innovation" and "Process Conflict" strategy (mixed strategy) is $U1=xU1P+(1-x)U1q$.

Substituting equation (1) and equation (2), hence

(3) $U1=xy\Delta R+xy\delta-x\delta-xyR+xyC+yR-yC+R1$

The replication dynamic equation of member 1 of the science and technology innovation team is $dx/dt=x(U1p-U1)$.

Substituting the results of (1) and (3) into the replication dynamic equation, hence

(4) $dx/dt=x(1-x)[y(\beta\Delta R+\delta+CR)-\delta]$

Similarly, assuming that member 2 chooses the "Innovation" strategy, the expected return is $U2p$, so

(5) $U2p=x[R2+(1-\beta)\Delta R]+(1-x)(R2-\delta)$

Choosing the "Process Conflict" strategy's expected return is $U2q$, so

(6) $U2q=x(R2+RC)+(1-x)R_2$

The average expected return of the mixed strategy of member 2 is $U2$, so $U2=yU2p+(1-y)U2q$.

Substituting formula (5) and formula (6) into, hence

(7) $U2=yx(1-\beta)\Delta R+yx\delta-y\delta-yxR+yCx+xR-Cx+R2$

The replication dynamic equation of member 2 of the science and technology innovation team is $dy/dt=y(U2p-U2)$.

Substituting formula (5) and formula (7) into, hence

(8) $dy/dt=y(1-y)[x(1-\beta)\Delta R+x\delta-xR+Cx-\delta]$

Finally, obtaining the five balance points of the conflict game dynamic system between member 1 and member 2: $O(0,0)$, $A(0,1)$, $B(1,1)$, $C(1,0)$, $D\{\delta/[(1-\beta)\Delta R+\delta+CR],\ \delta/(\beta\Delta R+\delta+CR)\}$.

Table 2 Evolutionary game matrix of process conflict evolution of asymmetric members of the science and technology innovation team

		Member 1	
Member 1	Innovation y		Process conflict $(1-y)$
	Innovation x	$R_1+\beta\Delta R$, $R_2+(1-\beta)\Delta R$	$R_1-\delta$, R_2+RC
	Process conflict $(1-x)$	R_1+RC, $R_2-\delta$	R_1, R_2

Evolutionary stability analysis of member 1's strategy

Let $F1(X)=dx/dt$. When $F1'(X^*)<0$ and $[y(\beta\Delta R+\delta+CR)(1-2x)]<0$, X^* is an evolutionary stability strategy. If $y=\delta/(\beta\Delta R+\delta+CR)$ and $dx/dt=0$, any x is stable.

(1) When $R>\beta\Delta R$ and $(R-C)<\beta\Delta R$, the excess income obtained by member 1 of the science and technology innovation team adopting the "Innovation" strategy is greater than the net gain obtained by member 1 of the science and technology innovation team adopting the "Process Conflict" strategy and $0<[\delta/(\beta\Delta R+\delta+CR)]<1$.

If $y>[\delta/(\beta\Delta R+\delta+CR)]$ and $F1'(1)<0$, $x^*=1$ is the evolutionary stable strategy, the game result is: when the probability of member 2 choosing the "Innovation" strategy is greater than a constant value, member 1 finally chooses the "Innovation" strategy.

If $y<[\delta/(\beta\Delta R+\delta+CR)]$ and $F1'(0)<0$, $x^*=0$ is the evolutionary stable strategy, the game result is: when the probability of member 2 choosing the "Innovation" strategy is less than a constant value, member 1 finally chooses the "Process Conflict" strategy.

1. When $R>\beta\Delta R$ and $(R-C)>\beta\Delta R$, member 1 adopts the "Process Conflict" strategy, the net gain is greater than the "Innovation" strategy's excess gain, $0<[\delta/(\beta\Delta R+\delta+CR)]$ or $[\delta/(\beta\Delta R+\delta+CR)]>1$ and $F1'(0)<0$. So $X^*=0$ is the evolutionary stability strategy. The result of the game is: when member 1 adopts the "Process Conflict" strategy, the net gain is greater than the excess income obtained by adopting the "Innovation" strategy. No matter what strategy member 2 chooses, member 1 will choose the "Process Conflict" strategy.
2. When $R<\beta\Delta R$, the gain obtained by member 1 adopting the "Process Conflict" strategy is less than the excess gain obtained under the "Innovation" strategy and $0<[\delta/(\beta\Delta R+\delta+CR)]<1$ (the situation at this time is similar to the first situation).

If $y>[\delta/(\beta\Delta R+\delta+CR)]$, $F1'(1)<0$, $x^*=1$ is the evolutionary stability strategy. The game result is: when the probability of member 2 choosing "Innovation" strategy is greater than a constant value, member 1 will eventually choose "Innovation" strategy. If $y<[\delta/(\beta\Delta R+\delta+CR)]$, $F1'(0)<0$, $x^*=0$ is the evolutionary stable strategy. The game result is: when the probability of member 2 choosing "Innovation" strategy is less than a constant value, member 1 chooses "Process Conflict" strategy.

Evolutionary stability analysis of member 2's strategy

The analysis process is the same as that of member 1. Let $F2'(y)=dy/dt$. When $F2'(y^*)<0$, $[x(1-\beta)\Delta R+x\delta-xR+Cx-\delta](1-2y)<0$ is an evolutionary equilibrium strategy. When $x=\delta/[(1-\beta)\Delta R+\delta+CR]$, $dy/dt=0$, any y is stable.

Other analysis is the same as that of member 1 and the following phase diagram is obtained:

When $R>(1-\beta)\Delta R$ and $(R-C)<(1-\beta)\Delta R$, $0<[\delta/(1-\beta)\Delta R+\delta+CR]<1$. When $x>\delta/[(1-\beta)\ \Delta R+\delta+CR]$, $F2'(1)<0$, so $y^*=1$ is the evolutionary stability strategy. When $x<\delta/[(1-\beta)\ \Delta R+\delta+CR]$, $F2'(0)<0$, so $y^*=0$ is the evolutionary stability strategy.

1. When $R>(1-\beta)\Delta R$ and $(R-C)>(1-\beta)\Delta R$, $1<[\delta/(1-\beta)\Delta R+\delta+CR]$ or $[\delta/(1-\beta)\Delta R+\delta+CR]<0$, there is always $F2'(0)<0$. So $y^*=0$ is the evolutionary stable strategy.

2. If $R>(1-\beta)\Delta R$, $0<[\delta/(1-\beta)\Delta R+\delta+CR]<1$, which is similar to the first case. When $x>\delta/[(1-\beta)\Delta R+\delta+CR]$, $F2'(1)<0$, $y^*=1$ is the evolutionary stability strategy. When $x<\delta/[(1-\beta)\Delta R+\delta+CR]$, $F2'(0)<0$, so $y^*=0$ is the evolutionary stability strategy.

In summary, the strategy dynamic evolution graph of member 1 and member 2 is shown in figure 2.

It can be seen from figure 2 that among the five equilibrium points of the game, point *D* is the saddle point, point *O* and point *B* have evolved to a stable state and point *A* and point *C* are the starting points of the unstable source. When the members of an enterprise's science and technology innovation team choose "Innovation", the excess returns are less than the benefits of choosing "Process Conflict". But when the benefits of point C are greater than the net benefits of "Process Conflict", either strategy, "Innovation" or "Process Conflict", may be chosen. The specific strategy adopted depends on the rate of "Innovation" adopted by the other member. However, the ultimate result of the long-term evolution of the process conflict game of the members of the enterprise's science and technology innovation team, either choosing "Innovation" or "Process Conflict", is that the strategies adopted by the two parties will tend to be consistent. For member 1 of the science and technology innovation team, the choice of "Innovation" strategy among members can be maintained by controlling the ratio between y and $[\delta/(\beta\Delta R+\delta+CR)]$. For member 2 of the science and technology innovation team, the choice of "Innovation" strategy among members can be maintained by adjusting the ratio between x and $\delta/[(1-\beta)\Delta R+\delta+CR]$. By adjusting and controlling the profit and loss of the team members, the process conflicts are maintained at an appropriate level, so that the team can maintain innovation, increase organizational vitality, employee motivation and corporate income.

The above research shows that in task conflicts, process conflicts and innovation game decision-making, on the one hand, conflicts are inevitable, the selection of members is unstable and vicious conflicts cannot effectively promote innovation. But on the other hand, conflicts can be effectively controlled to make them keep the moderately controllable state. Therefore, the probability of members choosing "Innovation" strategies should be higher than the probability of members choosing "Conflict", the rewards of innovation strategies and the punishment of conflict strategies should be appropriately increased and the strength and coefficient of punishment caused by conflicts should be adjusted to control team members' benefits for leading to rational decision-making. Because in the long-term research and development process of the science and technology innovation team, the team members are always in a state of bounded rationality, it is not possible to promote members to choose innovation strategies as much as possible based on the adjustment of innovation benefits. Through the establishment of other flexible adjustment mechanisms, the innovation status of the science and technology innovation team will be improved greatly.

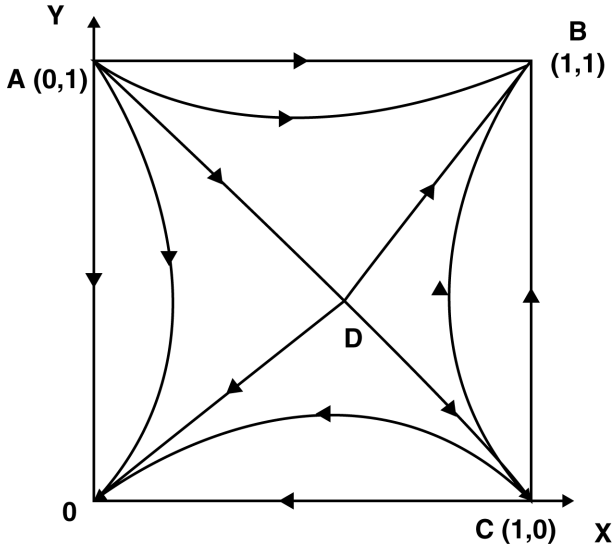

Figure 2 Dynamic evolution diagram in process conflict game model.

RESULTS

When task conflicts and process conflicts occur, whether to choose "Conflict" or "Innovate" which depends on the members' excess income from choosing "innovative" behavior and the amount of punishment they will receive. Judging from the conflict model assumptions and analysis results, when a member faces conflict, whether to choose innovation or conflict depends on the magnitude of the conflict's net return "*R*-*C*" and innovation's additional return "ΔR". Among them, the greater the cost of conflict and the smaller the net benefit of conflict, the greater the probability of choosing innovation. Therefore, we can promote team innovation from the point of improving the constructive conflict management system. We should start with constructive conflict management, establish a fair and just system, reasonably manage and control the magnitude of constructive conflicts. The daily management of the science and technology innovation team can appropriately improve the positive benefits of the constructive conflict, increase the punishment for the destructive conflict and allow members to make rational decisions when conflicts occur and choose innovative strategies. Although members are bounded rational, with institutional constraints, members can choose to remain rational to restrain their vicious actions, thereby increasing the overall level of positive conflict in the team, effectively promoting innovation and making team management effective.

In addition, some researchers had pointed out that as team develops over time, the team members develop concord with others in team and perceive less potential conflict about their team work.[36] Science and technology innovation team, for promoting scientific research work, should establish a trusting communication environment and convenient communication channels in the team to avoid destructive conflicts caused by the lack of communication due to the differences in technology innovation team members, personal emotions, different work concepts and methods and so on. Finally, the study believes that we must focus on the innovation power of the science and technology innovation team and on the innovation of management technology. Combined with modern information management technology, science and technology innovation team can solve the problems that were difficult to be found or

accumulated for a long time under the previous management mechanism and improve the team's innovation ability.

DISCUSSION

The research constructs the evolutionary game model of task and process conflicts and studies the relationship between the constructive conflicts and team innovation in the science and technology innovation team. However, the study exists some study limitations in methodology, theory, research scope and so on. First, because the relevant game research results on constructive conflicts of science and technology innovation teams are relatively lacking, only theoretical and case study methods are used. In a word, empirical research methods are not adopted by this article. Second, the establishment of the game model is based on some specific assumptions, but in reality, there are more than two players in the game and the game decision is not just a few choices. The game model, using smaller sample size, cannot accurately describe all changes in the actions of the members of the science and technology innovation team, so the research conclusions are negatively affected. Finally, the focus on just positive conflicts without addressing how to mitigate negative ones is also a flaw that should be noted, as a team experience both conflicts in a non-isomorphic configuration. In the specific field of teams, interventions can be addressed also to the "other side of the coin".[37] For example, relationship conflicts in team, a type of negative but important conflict, can hinder a creative team environment.[38] However, this study does not cover the impact of relationship conflict.

In order to compensate for the limitations of the research and better reflect the nature of the science and technology innovation team of the health organization, future research will be carried out from the following aspects: (1) trying to use empirical research methods to analyze innovation management of science and technology innovation team members based on constructive conflict; (2) by expanding sample size to improve the accuracy of the research results of the conflict evolution game model; (3) considering to construct an evolution game model based on relationship conflict for science and technology innovation team of health organization.

Acknowledgements The authors would like to thank the Academic Committee of the School of Economics and Management of Xi'an Technological University, the Graduate School of Xi'an Technological University and Xi'an International Medical Investment Co., Ltd for helpful assistance related to this work.

Contributors TW: conceptualization, writing—original draft project administration. QW: validation, project administration. KX: formal analysis. JZ: investigation. HO: supervision.

Funding The National Natural Science Foundation of China "Research on Innovation Promotion Effect and Innovation Management Mechanism of Science and Technology Innovation Team Based on Conflict Mechanism" (Grant No. 71572137).

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data sharing not applicable as no datasets generated and/or analyzed for this study.

ORCID iD

Qi Wang http://orcid.org/0000-0003-3558-8388

REFERENCES

1 Ratzmann M, Pesch R, Bouncken R, *et al*. The price of team spirit for sensemaking through task discourse in innovation teams. *Group Decis Negot* 2018;27:321–41.
2 Weingart LR, Todorova G, Cronin MA. Task conflict, problem-solving, and yielding: effects on cognition and performance in functionally diverse innovation teams. *Negot Confl Manag Res* 2010;3:312–37.
3 Wan T, Otsuki H. Game research on process conflicts under the bounded rationality of science and technology innovation team numbers. *Syst Eng Theory and Practice* 2018;38:2629–37.
4 Tjosvold D. The conflict-positive organization: stimulate diversity and create unity. *Addison-Wesley Series on Organization Development* 1991.
5 Lancker JV, Mondelaers K, Wauters E, *et al*. The organizational innovation system: a systemic framework for radical innovation at the organizational level. *Technovation* 2016;53:40–50.
6 Dreu CKWD, DeDreu C, Innovation T. Team innovation and team effectiveness: the importance of minority dissent and reflexivity. *Eur J Work Organ Psycho* 2002;11:285–98.
7 Camelo-Ordaz C, García-Cruz J, Sousa-Ginel E. The influence of top management team conflict on firm Innovativeness. *Group Decis Negot* 2015;24:957–80.
8 Tjosvold D, Wong ASH, Feng Chen NY. Constructively managing conflicts in organizations. *Annu. Rev. Organ. Psychol. Organ. Behav.* 2014;1:545–68.
9 O'Neill TA, McLarnon MJW. Optimizing team conflict dynamics for high performance teamwork. *Human Resource Management Review* 2018;28:378–94.
10 Mohrmann G, Kraatz D, Sessa B. Optimizing the business and IT relationship--a structured approach to implementing a business relationship management framework. *J Healthc Inf Manag* 2009;23:52–9.
11 Wan T, Zhou Y. Process Conflict Evolution Game Research of the R&D Team Members. *J Wuhan Univ Technol* 2014;2:232–7.
12 Drew F. *Game theory*. Beijing: China Renmin University Press, 2010.
13 X.W L. *Advanced dictionary of management*. Shanghai: Shanghai Lexicographical Publishing House, 2013.
14 Storme M, Lubart T, Myszkowski N, *et al*. A cross-cultural study of task specificity in creativity. *J Creat Behav* 2017;51:263–74.
15 Tjosvold D, Hui C, Law KS. Constructive conflict in China: cooperative conflict as a bridge between East and West. *J World Bus* 2001;36:166–83.
16 Vollmer A. Conflicts in innovation and how to approach the "last mile" of conflict management research – a literature review. *Int J Confl Manag* 2015;26:192–213.
17 Sandra BR. Constructive conflict in teamwork. *J Interdiscip Multidiscip Res* 2013;9:105–13.
18 Wu Y, Zhou Q. The No-cooperative game analysis of team conflict. *J Sci Technol Policy Manag Res* 2012;32:143–6.
19 Wan T, Otsuki H. Application research on game calculus of asymmetric conflicts between two persons in science and technology innovation team. *J Sci Technol Policy Manag* 2017;37:116–21.
20 Pook N, Stability K. *Efficiency, and Equity in Network Formation Games[M*. Creighton University, ProQuest Dissertations Publishing, 2014.
21 Zhao X, Hu B. Research on conflict behavior between Enterprises and employees based on catastrophe theory and evolutionary game. *Int Ser Oper Res Manag Sci* 2016;4:228–37.
22 Jehn KA, De Wit FRC, Barreto M, *et al*. Task conflict asymmetries: effects on expectations and performance. *Int J Confl Manag* 2015;26:172–91.
23 Wei XH, Liu YM, Che XL. Management of relationship conflict: the moderating effects of team efficacy and team emotional intelligence. *J Syst Manag* 2015;1:138–45.
24 Bouncken R, Barwinski R. Shared digital identity and rich knowledge ties in global 3D printing—A drizzle in the clouds? *Glob Strategy J* 2020.
25 Adams JD, Black GC, Clemmons JR, *et al*. Scientific teams and institutional collaborations: evidence from U.S. universities, 1981–1999. *Res Policy* 2005;34:259–85.
26 Bouncken R, Brem A, Kraus S. MULTI-CULTURAL teams as sources for creativity and innovation: the role of cultural diversity on team performance. *Int. J. Innov. Mgt.* 2016;20:1650012.
27 Bouncken R, Cesinger B, Tiberius V, Narcissism TV. Narcissism, Machiavellianism, and psychopathy of top managers: can Entrepreneurial orientation secure performance. *IJEV* 2020;12:273–302.
28 Castellani P, Rossato C, Giaretta E, *et al*. Tacit knowledge sharing in knowledge-intensive firms: the perceptions of team members and team leaders. *Rev Manag Sci* 2021;15:125–55.
29 Covin JG, Rigtering JPC, Hughes M, *et al*. Individual and team entrepreneurial orientation: scale development and configurations for success. *J Bus Res* 2020;112:1–12.
30 Pesch R, Bouncken RB. How to achieve benefits from diversity in international alliances: mechanisms and cultural intelligence. *Glob Strategy J* 2018;8:275–300.
31 Tajfel H, Turner J. An integrative theory of intergroup conflict. *The social psychology of intergroup relations* 1979;33:94–109.

32 Liu N, Zhao M. Coordination of the relationship between task and relationship conflict in teams. *Sci Res Technol Mana* 2012;32:179–82.
33 Wan T, Zhao Y. Research on Team Leader's Role in Conflict and Conflict Management. *Sci Res Technol Manag* 2012;32:140–3.
34 DeShon RP, Kozlowski SWJ, Schmidt AM, *et al*. A multiple-goal, multilevel model of feedback effects on the regulation of individual and team performance. *J Appl Psychol* 2004;89:1035–56.
35 Humphrey SE, Aime F, Cushenbery L, *et al*. Team conflict dynamics: implications of a dyadic view of conflict for team performance. *Organ Behav Hum Decis Process* 2017;142:58–70.
36 Susskind AM, Odom-Reed PR. Team Member's Centrality, Cohesion, Conflict, and Performance in Multi-University Geographically Distributed Project Teams. *Communic Res* 2019;46:151–78.
37 Peñarroja V, González-Anta B, Orengo V, *et al*. Reducing relationship conflict in virtual teams with diversity Faultlines: the effect of an online affect management intervention on the rate of growth of team resilience. *Soc Sci Comput Rev* 2020:089443932090757.
38 Pesch R, Bouncken RB, Kraus S. Effects of communication style and age diversity in innovation teams. *Int. J. Innov Technol. Management* 2015;12:1550029.