

# The Influence of Interpersonal Situation on Junior High School Students' Joint Action: The Moderating Effect of Empathy

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**Abstract:** This study uses the joint Simon task paradigm to conduct experimental research, and innovatively adds the new interpersonal situation of "competition in cooperation". Based on exploring the impact of interpersonal situation types on junior high school students' joint action, further studies the role of empathy in it. The results show that the type of interpersonal situation has an impact on junior middle school students' joint action, and the performance of individual joint action in the competition in cooperation situation is the best, and the performance in the competition situation is the worst. This study finally supports the reference coding theory and broadens the understanding of the common representation hypothesis from the perspective of joint action. At the same time, it also verified that empathy ability has a regulating effect on the relationship between interpersonal situation type and junior high school students' joint action, so it can be seen that cultivating students' empathy ability can help improve their cooperation ability.

**Keywords:** interpersonal situation, Joint action, empathy, junior high school students, referential coding

## 1. Introduction

Cooperation is the survival principle of species, which is unique and universal, which is pervasive in various social lives (Gaechter&Herrmann, 2009)<sup>[1]</sup>, the survival and development of individuals also depend on cooperation with others. Joint action is one of the main forms of cooperation. Usually, Joint action means that people coordinate their actions precisely in time and space (Sebanz, Knoblich, Prinz, & Wascher, 2006)<sup>[2]</sup>. In order to enable individuals to achieve a common goal in the process of interacting with others in both directions, in a broad sense Joint action is a social interaction. Vesper, et al. (2016) proposed that in order to achieve accurate coordination and cooperation between individuals in time and space dimensions, they need to adopt various mechanisms, but current studies have not fully explained the essence of Joint action.

The Joint Simon task is one of the main research paradigms that researchers have involved in the study of Joint action in recent years (Sebanz, Knoblich, & Prinz, 2003)<sup>[3]</sup>. In the process of completing the Joint Simon task, the individual not only forms a cognitive representation of his own behavior, but also a representation of the behavior of the co-actor, through the representation of his own and others' actions and spatial dimensions, thus reintroducing the feature overlap of the spatial stimulus-response dimension. As with the standard Simon task, consistency between the spatial stimulus position and the spatial response position promoted the execution of the joint task, while inconsistency resulted in response inhibition (Ferraro, Iani, Mariani, Milanese, & Rubichi, 2011)<sup>[4]</sup>. The Joint Simon effect generated by individuals completing Joint Simon tasks is also an important criterion for exploring the degree of integration between themselves and others, and can be used as an indicator to measure the performance of participants in completing Joint actions.

Previous studies have shown that the interpersonal situation of cooperation and competition will affect the Joint Simon effect, but researchers have not reached a consensus on this issue. The study by Ruissen Margit et al. (2016)<sup>[5]</sup> aimed to eliminate the impact of guidance language settings on participants completing Joint Simon tasks in both cooperative and competitive contexts. Before participants completed the Joint Simon task, they were asked to play Tetris to manipulate the contexts. The study found that established cooperative or competitive relationships were sufficient to affect individuals' level of self integration in completing subsequent joint tasks. Jonathan and Kerstin (2018)<sup>[6]</sup>

demonstrated that participants exhibited Joint Simon effects under independent, cooperative, and competitive conditions, but the Joint Simon effect under competitive conditions was smaller than that under cooperative conditions. In summary, interpersonal context is one of the important influencing factors for individuals to complete Joint Simon tasks and has a significant impact on the completion of Joint actions.

From the perspective of empathy, the target stimulus that an individual receives and processes refers to his or her perception of the situation and his or her perception and awareness of the emotions and attitudes of others, they then experience, understand, and produce emotions and perceptions similar to those of others. In order to process relevant information more accurately, individuals need to make full use of specific situational clues, and at the same time, they need to dig and understand some social requirements or implied social meanings that are not clearly expressed in specific situations (Kuzmanovic, Schilbach, Lehnhardt, Bente, & Vogeley, 2011)<sup>[7]</sup>. At this time, it is often necessary for individuals to make certain inferences by integrating clues and information in the situation. The interaction and cooperation between individuals and others in the social context will inevitably be affected by personality traits and empathy ability. Rumble (2010) pointed out that an individual's acquisition of some personality information about others has a certain impact on the degree of empathy experienced by an individual to others, and the degree of empathy experience will affect the level of cooperation in social dilemmas. There is a close relationship between empathy and individual Joint action, and empathy is a positive factor in individual prosocial behavior, which can promote the generation of cooperative behavior in Joint action.

On the basis of previous studies, this study took the Joint Simon task as the main experimental paradigm of the research, innovatively added the new interpersonal situation of "competition in cooperation", and took individual empathy ability into account to further explore the role of empathy in the impact of interpersonal situation types (cooperation/competition/competition in cooperation) on junior high school students' Joint action. In order to improve the relevant research on junior high school students' Joint action from the perspective of interpersonal situation type and empathy ability, and explore the influencing factors and influencing mechanisms of junior high school students' cooperation ability. By using experimental research as a scientific research method, it is more convincing for students to have a correct understanding of cooperation and competition through rigorous data after personally participating in experimental tasks and experiencing them; And provide theoretical support for gradually guiding junior high school students to objectively, rationally, and correctly approach cooperation and competition, cultivate and enhance their cooperation and empathy abilities, further help junior high school students establish a correct awareness of cooperation and competition, and also propose some new perspectives and suggestions for teacher education and teaching work.

## **2. Empirical Research**

### **2.1. Research Methods**

#### **2.1.1. Subjects**

72 middle school students (all right-handed) were recruited to participate in the experiment, the subjects were randomly assigned to three interpersonal situations of cooperation/ competition/ Competition in cooperation, 24 subjects in each situation, and the two subjects who completed the task were of the same gender.

#### **2.1.2. Experimental materials**

##### **(1) Interpersonal Response Indicator Scale (IRI-C)**

In previous studies, researchers used IRI-C to measure individual trait empathy (Sun Wei, 2016). Therefore, in this study, the Interpersonal Response Indicator (IRI-C) scale revised by Wu Jingji et al was selected to measure junior high school students' empathy ability (trait empathy). The internal consistency coefficient of this scale in this study was 0.73, indicating that the reliability met the standard.

##### **(2) Joint Simon Task**

The stimulus is a red/green solid square from the classic Simon Task. The task consisted of four conditioned stimuli: left/red solid square, left/green solid square, right/red solid square, and right/green solid square. Each subject was asked to respond to a stimulus of only one color, with subjects sitting on

the left and right index fingers pressing the “Z” and “/” keys to respond to the task, respectively (Ferraro, et al., 2012).

### 2.1.3. Experimental design

The experiment was a mixed experimental design of 2 (spatial consistency: consistency, inconsistency) X 3 (interpersonal context: cooperation, competition, and competition in cooperation). In this study, consistency was used as the intra-group variable, and interpersonal context was used as the inter-group variable, and the setting of interpersonal context was controlled by the instructions presented on the computer screen before the formal start of the Joint Simon task experiment.

### 2.1.4. Experimental procedures

The experimental task in this study consisted of two parts: practice test and formal test. In the practice stage, the subjects were given feedback on whether their keys were accurate after each trial. After the completion of the practice stage, the subjects pressed “Q” or “P” keys according to their actual conditions according to the instructions (Q-continue to practice; P- Formal experiment). In the formal experiment, the instruction was immediately followed by a central fixation point of 800ms, and then two colored squares were randomly presented on the left and right sides of the computer screen, and the subjects were required to respond to the stimulus within 1000ms. The stimuli disappeared after the subjects performed the keystroke response (followed by an empty screen period of 500 ms), and then proceeded to the next trial. (Ruys & Aarts, 2010; Iani et al., 2011; Jonathan et al., 2018)<sup>[8]</sup>

## 2.2. Results and analysis

### 2.2.1. Descriptive statistical analysis of empathic ability

Trait empathy was measured by IRI-C before the experiment began. Since this study aims to consider the role of overall trait empathy in the influence of interpersonal situation types on junior high school students' Joint actions, the dimensions under this scale were not considered separately. Table 1 provides descriptive statistical data on the measurement of empathy ability in different interpersonal situations. After the difference test, there were no significant differences in the total score of empathy and the four measurement dimensions of the subjects in different interpersonal situation groups, and the *p* were all greater than 0.05.

Table 1: Descriptive Statistics of IRI Scale (*M*±*SD*)

	competition in cooperation (N=24)	Cooperation (N=24)	Competition (N=24)
perspective taking (PT)	13.71±5.14	12.96±4.75	12.42±3.84
Fancy space (FS)	16.63±4.79	16.38±4.5	13.75±5.20
empathy concern (EC)	10.13±4.68	8±4.49	8.96±4.90
Personal Distress (PD)	17.58±3.13	16.67±4.58	16.13±4.34
IRI Total score	58.04±12.59	54±13.94	51.25±13.91

### 2.2.2. Analysis of Joint Simon task results

The outliers of the data were screened before data processing, and the error trials (including those that did not respond in the experiment and those that did not respond in the experiment) as well as the trials with reaction time less than 200ms and those with reaction time greater than 1000ms were eliminated (Yamaguchi et al., 2016). The rejection rate was 2.1%. Then all the data were sorted out and recorded into SPSS23.0, and 2 × 3 repeated measurement ANOVA was performed for response and accuracy respectively. The descriptive statistical analysis results of response time and accuracy in different interpersonal situations are shown in Table 2.

Table 2: Descriptive statistical analysis of response time and correct rate of Joint Simon task (*M*±*SD*)

Interpersonal situation	consistency	Reaction time (ms)	accuracy (%)
competition in cooperation (N=24)	Consistent	373.27±28.79	97.71±4.23
	inconsistent	392.80±30.00	95.73±4.00
	JSE	19***	1.98
cooperation (N=24)	Consistent	396.07±53.02	97.60±4.69
	inconsistent	408.07±50.63	96.56±4.22
	JSE	12***	1.04
competition (N=24)	Consistent	369.56±43.89	98.13±2.58
	inconsistent	375.59±42.44	95.94±4.35
	JSE	6	2.19

Note: \*represents *P*<0.05, \*\*represents *P*<0.01, \*\*\*represents *P*<0.001

(1) Reaction time analysis of the Joint Simon task

The results of response analysis show that the main effect of consistency is significant, the main effect edge of context is significant, and the interaction between consistency and context is significant. The simple effect analysis shows that the spatial consistency effect is significant in the competition situation, the cooperation situation is significant in the spatial consistency effect, and the competition situation is only marginal significance. Figure 1 shows the consistent and inconsistent response times in the three interpersonal situations.

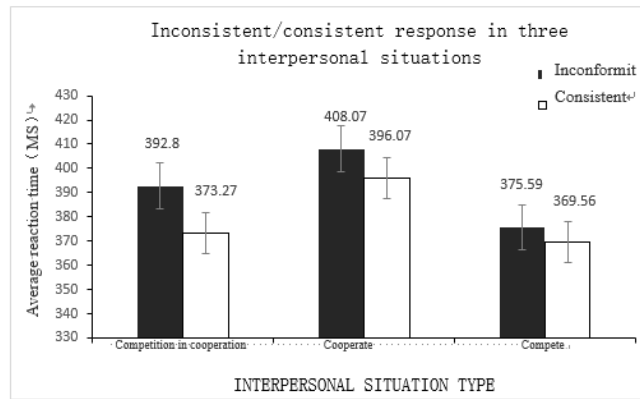


Figure 1: Joint Simon effect in Three Interpersonal Situations

Taking the task completion performance of the participants in the cooperative and competitive situation as the reference group, detailed results are shown in Table 3.

Table 3: Pairwise comparison of the joint Simon effect in various interpersonal situations

situation	situation	Mean difference(I-J)	Standard error	p
Competition in cooperation	cooperation	7.54	4.51	0.099
	Competition	13.51**	4.51	0.004

(2) Correct rate analysis of Joint Simon task

The results of correct rate analysis showed that only the main effect of consistency was significant in correct rate, that is, the correct rate of consistent trial (97.81%) was significantly higher than that of inconsistent trial (96.08%), and other effects were not significant. There was no similar result in the correct rate analysis as in the reaction time analysis, and the main reason for this problem may be that the error rate of the subjects in completing the task was relatively low, and the difference in the correct rate among individuals was small (Song Xiaolei, Li Yangyang, Yang Qian & You Xuqun, 2018).

2.2.3. Analysis of the impact of empathy on junior middle school students' Joint action in interpersonal situations

The purpose of this study is to explore the role of empathy in the influence of interpersonal situations on junior high school students' Joint action. Three interpersonal situations were set up in the behavioral experiment, but because the Joint Simon effect in the competitive situation was only marginal significant ( $p=0.063>0.05$ ), the study on the influence of empathy on the type of interpersonal situation on the Joint action of junior high school students was conducted without considering the competitive situation, and only the two interpersonal situations of cooperation and competition in cooperation were considered. At the same time, in order to verify hypothesis 3, it is necessary to further explore the relationship between empathy, interpersonal situation and Joint action, and test whether empathy plays a moderating role in the influence of interpersonal situation types on junior middle school students' Joint action.

In this study, the Joint Simon effect was used as the dependent variable, interpersonal situation as the independent variable, and empathy as the moderating variable. The results showed that the model was significant as a whole, the regression equation test is shown in Table 4.

Table 4: Test of regression equation

R	R2	MSE	F	df1	df2	p
0.598	0.358	144	4.678	5	42	0.0002

According to the results of model analysis, empathy has influence on the joint Simon effect. The interaction terms of interpersonal situation and empathy have a significant influence on the joint Simon

effect, indicating that empathy has a moderating effect on the influence of interpersonal situation type on the joint action of junior middle school students. Table 5 shows the regression analysis of the influence of interpersonal situation and empathy on joint action.

Table 5: Regression analysis of the influence of interpersonal situation and empathy on joint action

	$\beta$	SE	t	p	95% CI	
					Lower Limit	Upper limit
empathy	0.395	0.138	2.860	0.007	0.12	0.67
interpersonal situation	5.299	3.524	1.504	0.140	-1.81	12.41
empathy x interpersonal situation	0.569	0.275	2.069	0.045	0.01	1.13

According to the above analysis, it can be seen that the moderating effect of empathy is significant. A simple slope test is used to analyze the effect of different empathy ability on the influence of interpersonal situation types on junior middle school students' joint action. The results of simple slope test are shown in Table 6.

Table 6: Simple slope analysis

	$\beta$	SE	t	p	95% CI	
					Lower Limit	Upper limit
Low trait empathy group	-2.271	5.176	-0.439	0.663	-12.72	8.17
High trait empathy group	12.870	4.982	2.583	0.013	2.82	22.92

The simple slope test results indicate that for individuals with high empathy, the type of interpersonal situation has a significant impact on joint action among junior high school students, while for individuals with low empathy, the impact of interpersonal situation types on joint action among junior high school students is not significant. In addition, the impact of interpersonal situations on junior high school students' joint action was plotted when empathy was above and below a standard deviation, as shown in Figures 2.

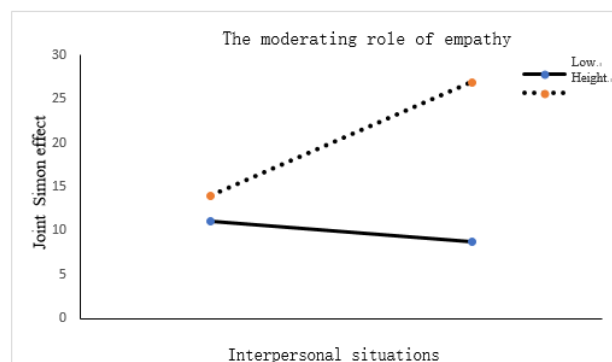


Figure 2: The moderating effect of empathy on the impact of interpersonal situation types on joint

### 3. Discussion and Analysis

#### 3.1. Influence of interpersonal situation on junior high school students' joint action

##### 3.1.1. Analysis of the impact of interpersonal situations on Joint action among Junior High School Students

The results show that interpersonal situations have an impact on junior high school students' joint action. However, in this study, the difference between the Joint Simon effect in the competition situation and the cooperation situation was only marginal significant, and the expected significant difference did not appear. The reasons for this result may be as follows. First, the essence of both competitive and cooperative situations in cooperation is cooperation, so the Joint Simon effect is also large when individuals complete the Joint Simon task in the cooperative situation. Second, in this study, it may be because even though the subjects have the external conditions of competition in cooperation, the lack of effective cooperation strategies and adverse interaction modes among individuals interferes with the intra-group cooperation and ultimately reduces the performance of the subjects in completing Joint actions under this situation. But the reasons for this result need to be explored continuously, and

the above is only a preliminary explanation.

### ***3.1.2. Mechanism analysis of the impact of interpersonal situations on Joint action among Junior High School Students***

The conclusion of this study is basically consistent with previous studies, that is, the type of interpersonal situation has different effects on the degree of self-others integration of individuals. In this study, the individual's Joint Simon effect was the highest in the competitive situation of cooperation, and the participants' performance in completing Joint actions was better than that in the cooperative and competitive situations. This result is consistent with the expected hypothesis of the study. The reasons for this result may be as follows: firstly, the essence of both competitive and cooperative situations in cooperation in this study is cooperation. Second, people unconsciously prefer to cooperate with co-actors to complete tasks and at the same time represent the tasks of co-actors, and this awareness is stronger when cooperation is required. In the situation of competition in cooperation, they will have more sense of opposition to the members outside the group and pay more attention to the tasks in the group. Third, in this situation, in order to compete with other groups, individuals must learn to cooperate and cooperate with their co-actors, so as to improve their inter-group competitiveness through cooperation.

In this study, the Joint Simon effect in the competition situation is not significant, only marginal significance, and the Joint Simon effect in this situation is significantly smaller than that in the cooperation competition situation. The reasons for this result may be as follows: First, in competitive situations, subjects have negative interpersonal relationships, which may increase the distance between the individual self and others, thus hindering the integration and representation of others' actions. Second, in the competitive situation, people's integration of the co-actor task representation is less than in the other two situations. Third, in the competitive situation, the perceived similarity between participants' own behavioral representations and those of others decreased. In summary, the results of previous studies and this study suggest that the common representation of tasks can be used as a potential cognitive mechanism for Joint action. The co-representation hypothesis focuses on co-representation; The reference coding theory focuses on the distribution of attention during Joint actions. Therefore, the results of this study support the reference coding theory and broaden the understanding of the common representation theory from the perspective of Joint action.

### ***3.2. The role of empathy in the impact of interpersonal situations on Joint action among junior high school students***

The research results of this study verified the expected hypothesis that empathy plays a moderating role in the influence of interpersonal situation type on junior middle school students' joint action. In addition, for individuals with high empathy ability, the type of interpersonal situation has a greater impact on joint action, that is, the better the performance of joint action completed in interpersonal situation. The reasons for these results may be as follows:

First, empathy helps individuals better pay attention to and perceive the feelings and needs of others, thus promoting their cooperative behavior in joint actions. Second, empathy can better help individuals understand and predict the emotions and behaviors of others, relevant studies have also proved that empathy can significantly positively predict individuals' sense of social responsibility. Third, the social information processing model points out that cue coding is the first step for individuals to produce cooperative behavior and prosocial behavior, and some scholars have also confirmed that empathy can be conducive to the formation of emotional tendency and cooperative behavior about cooperation in interpersonal communication (Rumble, Lange, & Parks, 2010)<sup>[9]</sup>. In summary, empathy plays a certain role in the influence of interpersonal situation types on joint actions of junior high school students. Therefore, cultivating empathy ability of junior high school students has extremely important theoretical and practical significance in promoting their cooperative ability, and also provides a new idea for teachers to improve the effectiveness of cooperative group teaching.

## **4. Limitations and prospects**

First, in the setting of the situation, what other methods can better manipulate the setting of interpersonal situations in laboratory studies to make subjects perceive the situation better, this question remains to be further explored. The findings in this study are only preliminary results, and only the trait empathy of the subjects is considered in this study, and state empathy is not taken into account.

Therefore, it is necessary to take both trait empathy and state empathy into consideration in future related studies, and conduct in-depth research on it from the perspective of cognitive processing. Finally, this study only explores the problems studied from the theoretical and behavioral aspects of behavioral experiments. In later studies, fMRI, ERP, eye tracker and other equipment can be used to explore the internal influence mechanism of interpersonal situation and empathy on joint action from a more microscopic perspective. We can also explore the more essential psychological mechanism of this problem by exploring groups with different characteristics (special groups).<sup>[10]</sup>

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