

# Agent-based Simulation of College Students' Risk Behaviors Caused by the Interpersonal Relationship

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## Abstract

College students are likely to have some risk behaviors such as suicide and hurting others. The interpersonal relationship is one of the critical factors which always affect the mental health of college student. Using the methods of questionnaire and agent-based simulation, this paper constructs a multi-agent model of college students' risk behaviors and studies the college students' behavior choice tendency under the influence of interpersonal relationship, the mechanism of college students' risk behaviors, and finds preventive measures. The results show that: the impact of interpersonal relationships on college students' risk behaviors is very significant; the risk behaviors of college students can be prevented by improving the interpersonal environment around them.

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## 1. Introduction

The prevalence of mental health problems among college students has increased steadily [1]. Colleges and Universities have reported unprecedented numbers of students in psychological distress [2]. 95% of college counseling center directors said the number of students with significant psychological problems is a growing concern in their center or on campus [3]. A web-based mental health survey was administered to first year students in 19 colleges across eight countries to screen for seven common DSM - IV mental disorders: major depression, mania/hypomania, generalized anxiety disorder, panic disorder, attention-deficit/hyperactivity disorder, alcohol use disorder, and drug use disorder, 38.4% screened positive for at least one 12-month disorder [4]. During college, students encounter new experiences, relationships, and living situations [5].

However, college students are not mature enough. Facing serious pressure and problems, college students are more likely to have mental health problems, or they may even have some risk behaviors, such as suicide and hurting others [6]. In recent years, there have been many unfortunate incidents about college students' suicide or impulsive injury to others. According to the American College Health Association (ACHA), suicide is currently the second most common cause of death among college students. There are many reasons why college students have suicidal ideation [7]. Students' bad emotion, personality and interpersonal and social relations may lead to the occurrence of risk behaviors. The interpersonal relationship problem is one of the most presenting concern among college students (35.8%). Many college students have personality independence and

strong self-consciousness, which may make them have interpersonal relationship problems. The interpersonal relationship problems may lead to serious consequences. Therefore, we should focus on the causes of students' risk behaviors from the perspective of interpersonal relationships and think about how to prevent such behaviors.

At present, the research on the factors related to college students' risk behaviors has attracted extensive attention. Norton et al. <sup>[8]</sup> studies the possible relationship between social anxiety and risk behaviors such as suicidal ideation among college students. Byrd et al. <sup>[9]</sup> investigates the individual, interpersonal, and institutional level factors that are associated with overall mental health among college students. Herawan et al. <sup>[10]</sup> studies the social anxiety of college students from five dimensions. Liu et al. <sup>[11]</sup> studies the high impacts of stress on mental health and suicidal point among college students. Taliaferro et al <sup>[12]</sup> identified risk and protective factors associated with greater emotional distress and suicide ideation among international college students. From the perspective of social interaction and interpersonal relationships. Darke et al. <sup>[13]</sup> found that social isolation is one of the important reasons leading to suicide and other risk behaviors. By using the principle of system dynamics, Shi et al. <sup>[14]</sup> conducted a simulation study on prevention and control intervention of college students' risk behaviors.

In recent years, agent-based modeling has been gradually applied to various fields of scientific research <sup>[15]</sup>. Agent-based modeling is a method for simulating the interactions between each individual agent <sup>[16]</sup>. Many research have also used simulations to study behaviors. Rosmalen et al. <sup>[17]</sup> constructs the MODEM virtual campus by simulation and simulates the social encounter. Ng et al. <sup>[18]</sup> studies the foraging behavior by constructing an agent-based model. Roza et al. <sup>[19]</sup> uses agent-based simulation to study the dynamic behavior of pedestrians. Gibson et al <sup>[20]</sup> studies the emergence behavior of unmanned aerial vehicle Search and rescue swarm by agents simulation. Luna-Ramirez et al. <sup>[21]</sup> aims

to bridge the gap in combining agent-based modeling and multi-agent systems approaches by integrating two major platforms in the field of Agent-Based Modeling and Belief-Desire Intention multi-agent systems, namely, NetLogo and Jason.

Therefore, this paper studies the college students' risk behaviors by simulation. By using the multi-agent simulation software Netlogo to simulate the college students, this paper designs a questionnaire and establishes a simulation model to answer the following questions:

- How does interpersonal relationships affect college students' risk behaviors?
- How does the impact of interpersonal relationships on college students' crisis behaviors arise?
- Which interpersonal relationship has a greater impact on risk behaviors?
- What is the proportion of college students who are easy to have risk behaviors due to interpersonal relationships?

The structure of the paper is as follows. The problems and methods of this paper is described in section 2. In section 3, we build an agent-based model of the college students and illustrate the basic assumptions and interaction rules of the model. In section 4, we use Netlogo to simulate the college students and analyze the effect of the interpersonal relationship on college students' risk behaviors. In section 5, based on the results of the simulation and questionnaire survey, we draw conclusions and give some suggestions on preventing college students' risk behaviors.

## 2. Problems and Methods Statement

In college, students from all over the world gather together, and each student has different habits and values. Contradictions and conflicts are inevitable between students, roommates and teachers and students. However, some students will take inappropriate ways to deal with interpersonal problems, causing tension in the relationship, so they may have social barriers and even hurt others.

There are many reasons why college students have risk behaviors due to interpersonal relationships. The main factors which can influence college students are shown as Fig.-1. College students have interpersonal conflicts because they have different personality characteristics, age, and gender. For example, those college students who are impulsive

and not calm are more likely to have conflicts with other people. Girls prefer cold violence to deal with problems. Senior college students are more likely to have risk behaviors because they have been in conflict with others for a long time. In college, the students mainly have conflicts with their roommates, teachers and classmates.

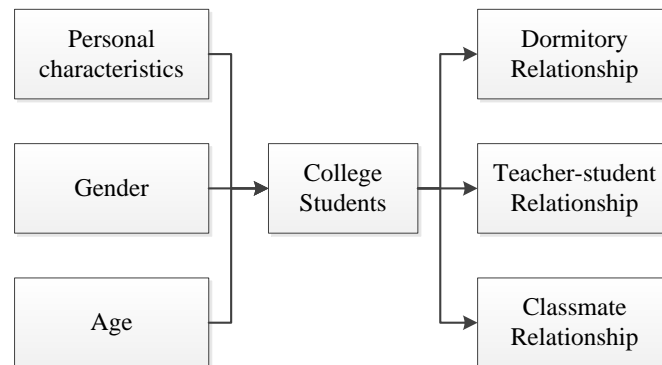


Fig.1. The factors which will influence the college students

To further analyze the influence of interpersonal relationships on college students' risk behaviors, this paper first designs a questionnaire and analyzes the results. The basic information of the questionnaire includes gender, age, grade, major and so on. The content of the questionnaire mainly investigates whether college students will have interpersonal relationship problems, with whom they will have interpersonal relationship problems, and what kind of treatment methods they will take. 300 copies of the questionnaire were collected. From the perspective of college students, the questionnaire can analyze the tendency and mechanism of risk behaviors of the respondents. Then considering the personality characteristics of college students and

the interaction rules between them, we construct an agent-based model to simulate the college students. NetLogo is a multi-agent programming language and modeling environment for simulating natural and social phenomena, and have been used in various fields [22]. With this software, we can better simulate the phenomenon that college students are independent and influence each other.

### 3. An agent-based model

We construct an agent-based model to analyze the effects of the interpersonal relationship on college students' risk behaviors. The research paradigm is described in Fig.-2.

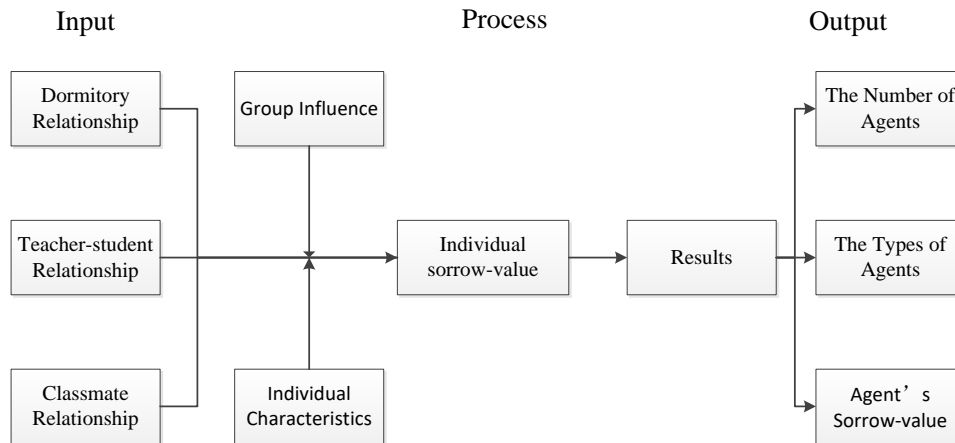


Fig.2. The Paradigm of The Research

The information obtained from the questionnaire is used to model the agent. We choose the dormitory relationship, the teacher-student relationship, and the classmate relationship as the influencing factors of the college students' risk behaviors and use "sorrow-value" to assess the possibility of risk behaviors among college students. According to the sorrow-value of each student, college students can be divided into three categories.

For the convenience of the research, the assumptions and symbols of the model are as following:

- (1) We use  $Agent_i (i=1,2,...,m)$  as a college student,  $breed_i (i \in \{sorrrows, middles, happys\})$  as the type of college students.
- (2) We use  $Gender_i = \{0,1\} (i=1,2,...,m)$  as the student's gender, which 0 is female and 1 is male.
- (3) We use  $Grade_i \in \{1,2,3,4\} (i=1,2,...,m)$  to represent the college students' grade.
- (4) In the questionnaire, we designs questions for the three types of the influencing factors, which the number of the questions is  $j$ , and by using the Fuzzy mathematics method, a scoring function  $Function_j(parameters)$  is designed for each question.
- (5) The sorrow-value of the agent which is calculated by the function  $Function_j(parameters)$  can be written as  $sv_{ij}$ .

$$sorrow - value_{ij} = sv_{ij} = \begin{bmatrix} sv_{11} & \dots & sv_{1n} \\ \dots & sv_{ij} & \dots \\ sv_{m1} & \dots & sv_{mn} \end{bmatrix} \quad (1)$$

$$(6) \quad sorrow - value_{Agent_i} = \sum_{j=1}^n Function_j \quad (parameters)$$

$(i=1,2,...,m)$ ,  $parameters=\{x_1, x_2, ..., x_i\}$ , which  $x_i$  is the option score of the questionnaire, and the score is returned randomly with the statistical frequency of the questionnaire. We assume that the weights of various factors in the function are regarded as the same, and the data analysis is not affected by normalization.

- (7) According to the statistical results of the questionnaire, the threshold  $\theta$  ( $\theta \in \{\theta_1, \theta_2\}$ ) of sorrow-value can be set. The type of "sorrrows" is more likely to have risk behaviors, the type of "happys" is rarely to have risk behaviors, the type of "middles" is normal people.

$$Agent_i (i=1,2,...,m) = \begin{cases} sorrrows & sv_i > \theta_1 \\ middles & \theta_2 < sv_i < \theta_1 \\ happys & sv_i < \theta_2 \end{cases} \quad (2)$$

- (8) In the Cartesian coordinate system, we assume that all agents within the radius of distance(constant) of each Agent and set this collection as  $Agent\_in\_distance_i$ . If all the other agents in this collection are members of "happy", then, in the period of  $t$ , the sorrow-value of this Agent will decrease  $\mu$ .

The agent-based models are composed of interacted agents within an environment [23]. In our model, we set that each agent has four attributes: gender, grade,

types and sorrow-value. The interaction rules of our agents are shown as Fig.-3.

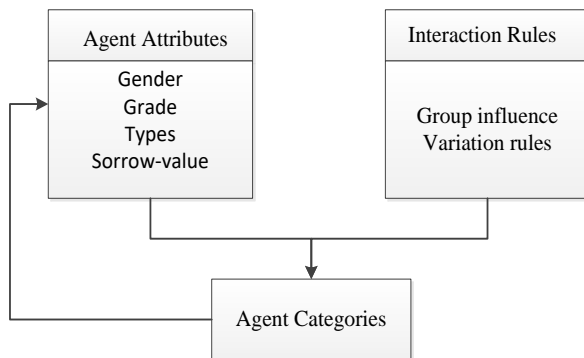


Fig.3. The interaction rules of agents

#### 4. Simulation

To further demonstrate the effect of the interpersonal relationships on the college students' risk behaviors, we simulate the real situation of college students. The simulation model was developed on a standard Acer laptop (Intel(R) Core(TM) i5-4200M CPU @ 2.5GHz 2.5GHz 8.00G RAM 64-bit OS), with Microsoft Windows 10 operating system on Netlogo 6.0.3 environment. The simulation flow is shown in Fig.-4. In this simulation, the range of the number of the agents is  $Agent\_number \in [100, 10000]$ ,  $\theta_1 = 25$ ,  $\theta_2 = 3$ , distance=3,  $\mu = 10$ .

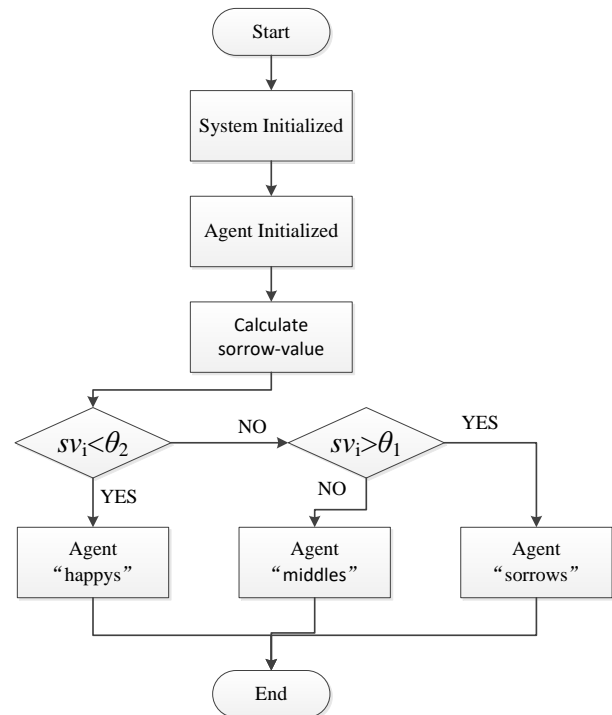


Fig.4. Simulation Flow

The main interface of the simulation is shown in Fig.-5. The “setup” button is designed to reset the parameters and the “go” button is designed to run the program. The “Agent-number” is set to control the number of the agents. The “run-time” is designed to control the running time of the simulation. The “Show-sorrow-value?” is designed to control the display of the value of sorrow-value. The “Count(sorrows, middles, happys)” measures the number of the agents of the three types.



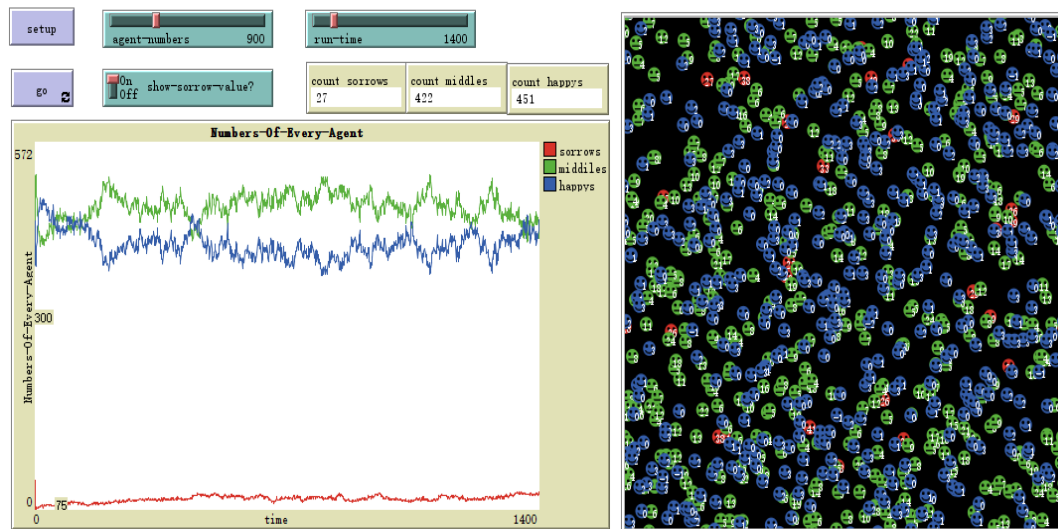


Fig.5. The Main Interface

After the system runs for 1400 units of time, the number of three types of agents changes as shown in Fig-6. The total number of the agents is 900. As is shown in Fig-6: the type of “sorrows” which is represented by the red line grows from more than 10 agents to about 30 agents; the number of “middles” is more than the number of “happys”; the red sorrow agents account for 3% of the total number of the agents.

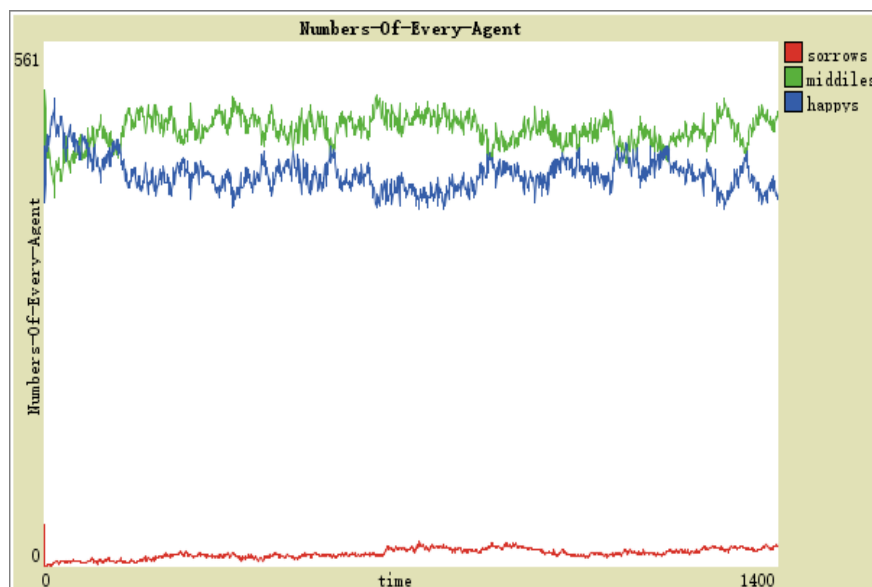
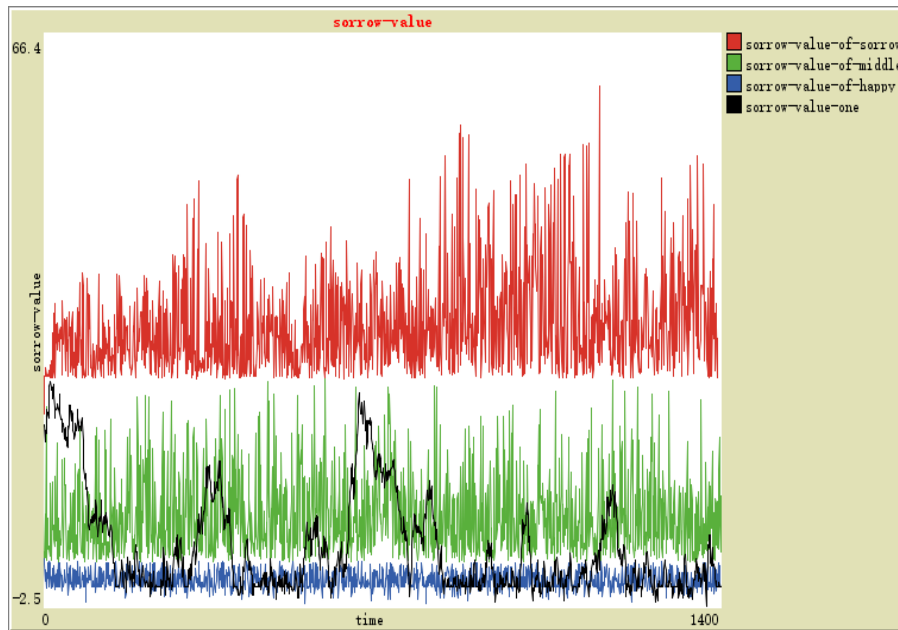


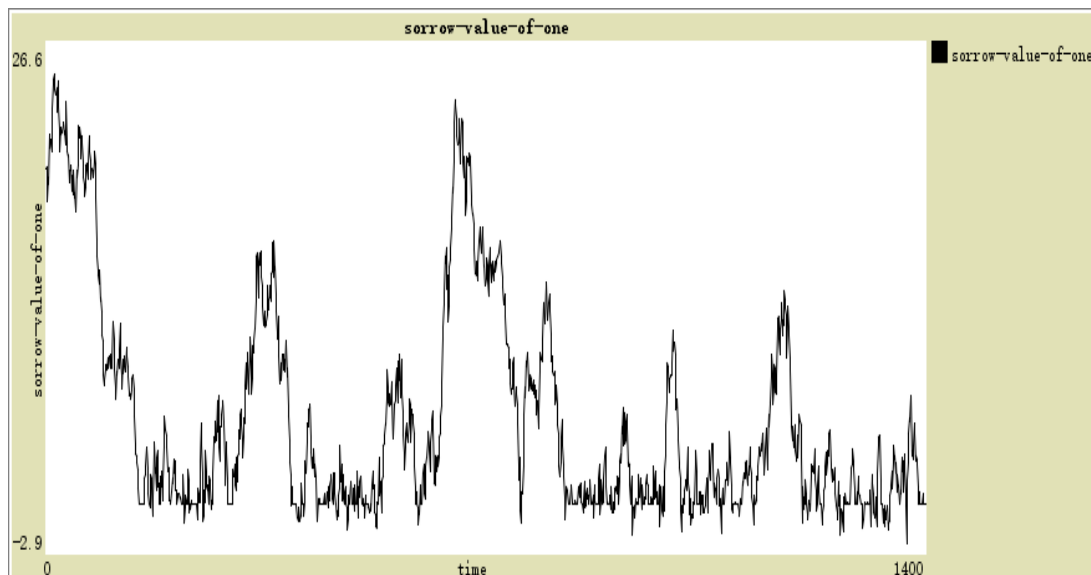
Fig.6. The Number of The Three Types of Agents



**Fig.7.** The Sorrow-value of The Tree Types Agents

The value of the agents' sorrow-value can be seen in Fig.7. The sorrow-value of the "sorrows" agents which is represented by the red line is basically at a high value, but the other two types are at a lower level. Fig.-7 illustrates that the three types of agents can be distinguished by the threshold of

sorrow-value, which can also prove the validity of our model. To describe in detail how an agent's sorrow-value changes, taking Agent 1 as an example, we plot the sorrow-vale change chart of the whole period.



**Fig.8.** The Sorrow-value Change Chart of Agent 1

As is shown in Fig.-8, Agent 1 is randomly divided into the situation that is surrounded by the risk agents, so the sorrow-value is relatively high. With the change of time, the sorrow-value of Agent 1

fluctuates significantly. Agent 1 is influenced by the interpersonal relationships, but there are only two peaks of risk tendency in the 1400 units of time, and Agent 1 is at normal state for most of the time. This

also correctly simulates the real life of a college student.

## 5. Conclusion

In the above simulation analysis and previous studies, it can be concluded that the impact of interpersonal relationships on college students' risk behaviors is very significant. In the questionnaire, we consider that the interpersonal relationships of college students consists of the dormitory relationship, the teacher-student relationship, and the classmate relationship. The results show that: about 47% of the respondents say that they are most likely to have conflicts with their roommates, about 18% think they will not be in harmony with their classmates, and 31% think they are more likely to conflict with strangers; the remaining 3% of respondents are more likely to have conflicts with their teacher. So the interpersonal relationship problem with roommates is the most common problem that college students have.

Facing the interpersonal problems, different ways of dealing with the problems will cause different results of risk behaviors. In the questionnaire survey results, we found that about 66% of students choose positive communication to solve the problem, and 30% choose to treat indifference. Those students who choose positive ways to solve the interpersonal conflicts are more likely to be reasonable and apologize to other people. People who are more optimistic are not influenced by negative friends. There are very few individuals with a tendency to have risk behaviors, which is only about 1%.

According to the results, in order to prevent the college students' risk behaviors, precautions are designed for the following problems respectively:

### (1) Personality problems

For personal characteristic problems, taking ordinary preventive measures is not enough to achieve the effect. We should provide psychological assistance to them. Mental health education should be adopted for those who have the tendency of risk behaviors.

### (2) Environmental factors

Students are easy to affect by their surroundings, a lot of risk behaviors come from the indifference of those around you <sup>[24]</sup>. Affection, information, familiarity, and trust social relationships exert a positive impact on social presence <sup>[25]</sup>. The support and timely communication from family, friends and classmates will greatly reduce negative emotions. Schools should pay more attention to the psychology of students, and timely detect the tendency of risk behaviors and prevent it.

### (3) The lack of awareness of the consequences

College students may lack understanding of the serious consequences of risk behaviors. The value of risk education has been proven <sup>[26]</sup>. In view of this problem, we must strengthen the publicity of legal knowledge. Students who are prone to have risk behaviors should be made aware of the serious consequences of their possible risk behaviors. School should use effective educational measurement to teach students that the serious consequences of the risk behaviors and the importance of taking responsibility for their risk behaviors.

Some of the risk behaviors of college students are also due to their mental health problems in adolescence. In the World Health Organization (WHO) study, the consequences of not addressing adolescent mental health conditions extend to adulthood, impairing both physical and mental health and limiting opportunities to lead fulfilling lives as adults <sup>[27]</sup>. Therefore, parents should pay attention to their children's mental health from childhood, communicate with them more, and guide their psychological development towards a healthy direction. We should also make mental health awareness and education become part of the curriculum in secondary and even primary schools.

This paper only studies the effect of interpersonal relationships on college students' risk behaviors, but there are many other factors which cause college students to have risk behaviors. In the future, we will use the simulation method to study the mechanism of risk behaviors analysis of college students from



more aspects, so as to effectively prevent and control it.

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