Research on the Escape Planning of Kindergarten Children

Yu Song [1a], Zhi-Wei JIA [2b]

[1]*College of Safety Science and Engineering, Henan Polytechnic University, Jiaozuo, 454000, Henan, China*
[2] *College of Safety Science and Engineering, Henan Polytechnic University, Jiaozuo,454000, China; Central Plains Economic Zone Coal Methane Cooperative Innovation Center in Henan Province, Jiaozuo, 454000, China, Henan, China*
[a]*2637386129@qq.com*
[b]*jia_206@126.com*

ABSTRACT
Based on the research of Pathfinder on children's emergency evacuation safety, this paper designs a set of plans for children to help each other in pairs and follow the teachers to escape, analyzes the current situation of children's emergency evacuation safety in China, puts forward measures to optimize children's emergency evacuation countermeasures, and clarifies the influence of different factors on children's emergency evacuation safety behavior and efficiency.

Keywords-*kindergarten; Safe evacuation; Countermeasures for helping; Children*

1. INTRODUCTION

In 1954, Festinger proposed the theory of social psychology [1-3]. Mintz, Keating and other scholars pointed out that the panic behavior of people in the process of evacuation in emergency events has the following points: the speed of crowd movement is faster than that under normal conditions [4-5]; Individual behavior shows a trend of group behavior [6-7].

The evacuation model established by Zhang Peihong, Lu Zhaoming [8] and others is a model based on individual behavior. Liu Qiangl's crowd evacuation model is based on the background of sports field emergencies and through the design algorithm of simulation computer for the accident emergencies [9]; The discrete micro simulation model established by Xu Gao is based on the existing micro simulation model of personnel evacuation, learning from each other's strong points to complement each other's weak points, and then simulating the safe escape of personnel in the subway station [10-11].

In view of the research on children's escape planning at home and abroad, this paper draws the following conclusions. At present, most of the research on escape planning is focused on adults, but few on the psychological and behavioral characteristics of children in emergency. In the event of an accident, the individual psychological behavior changes will affect the evacuation efficiency. The evacuation efficiency largely depends on the individual psychological behavior changes in the process of escape, and the individual psychological behavior response in the process of escape has great uncertainty. In order to improve the evacuation efficiency, eliminate or reduce the dangerous factors in the process of escape, it is very important to study the relationship between individual attributes and evacuation psychological behavior through the different evacuation behaviors of individuals in the same accident, and further analyze its impact on the evacuation efficiency, so as to provide guarantee for improving the evacuation efficiency.

2. MAIN FACTORS AFFECTING CHILDREN'S ESCAPE

2.1 Exit and path

When the accident happens suddenly, on the one hand, it is easy to miss the best time to escape due to the sudden accident, lack of psychological preparation and rapid transmission of panic. On the other hand, children's individual environment is not the same, the exit and path signs are not obvious, children are easy to get lost in the process of escape, make wrong decisions and judgments,

block the exit and path, increase the difficulty of evacuation, so the width, number and location of the exit and path will affect the safe evacuation of children.

2.2 Evacuation lighting and signs

Due to the poor identification ability of children, it should be noted that the signs should be obvious and easy to understand when setting evacuation signs, and the meaning of the signs should be explained to children in daily safety education, so as to improve children's cognitive ability and familiarity with the signs and ensure that children can quickly identify and make correct decisions according to the signs in the process of escape, choose the right escape route and exit.

3. ANALYSIS AND OPTIMIZATION OF EVACUATION SCHEMES

According to literature research and field investigation in kindergartens, it is found that compared with adults, children will have some unique escape behaviors, which will have a greater impact on the evacuation behavior of individual children. If these behaviors are used scientifically, the safe evacuation ability of children in kindergartens will be greatly improved.

a) Optimization of evacuation scheme

The pre evacuation time of 4-to-10-year-old children and adolescents is greatly influenced by teachers' actions and decisions [12]. However, due to the poor awareness of self-protection and low escape efficiency, the blind obedience behavior in the process of evacuation is prominent. It is self-evident that teachers should guide children to evacuate.

b) Reasonably arrange the ways of helping teachers and children

Suppose a group of help is composed of one teacher and five children. The teacher leads the children to carry out emergency evacuation. The fastest speed of emergency evacuation is obtained when the children's moving speed reaches the maximum. The emergency evacuation mode of children's pairing and mutual assistance following the teacher or queuing up is adopted.

4. PERSONNEL MODEL AND DATA ANALYSIS

Pathfinder uses the technology of computer graphics simulation and game role field to conduct a graphical virtual exercise for each individual in multiple groups, so as to accurately determine the fast escape path and escape time of each individual in the event of disaster.

a) Safe escape time

According to the relevant requirements of code for building design (GB 50016) (kindergarten) [13], the evacuation time of children in grade I and II of kindergarten is 3 minutes.

The total evacuation time required for evacuation to a safe area can be expressed as follows:

$$T_{REST}=T_{det}+T_{resp}+T_{more} \quad (1)$$

In the formula, the time required for safe escape, alarm evacuation, response and evacuation are in sequence.

The parameters T_{det} = 10s and T_{resp} = 10s were set by reference [14].

b) Determination of basic parameters of calculation model

In order to ensure more practical and scientific, a reasonable number of people should be set in the simulation process. According to the "kindergarten work rules" [15-16], 25 children and 5 teachers are conservatively set.

TABLE 1 RELEVANT PARAMETER VALUES

Personnel composition	*Shoulder width (m)*	*Average velocity (M / s)*
children	0.28	0.40
Male faculty	0.4	1.35
Female faculty	0.36	1.15

Because preschool children's psychological and physiological development is not perfect, individuals do not have the perfect ability to escape alone. In the process of help simulation, the teacher will help the children escape, which needs to set the movement speed of teachers and children to the same speed.

The results of the relationship between the safe escape time and the number of children in sfpe mode and steering mode show that: when sfpe mode is used for simulation, the number of children in safe escape reaches half when the escape process reaches 18s, and the escape speed reaches the highest when the escape process reaches 15s to 25s, and the utilization rate of safety exit reaches the highest when the escape process reaches 25s. The evacuation rate was 3.5pers/s. After 25 seconds, the utilization rate of emergency exit decreased significantly, and the evacuation rate began to decrease to 3 pers / s. When the steering mode is used to simulate the escape process, the number of people escaping safely reaches half when the escape process reaches 15s, and the curve between the escape time and the number of people escaping is basically smooth between 10s and 20s, that is,

the evacuation rate is basically unchanged at 3.5pers/s. In the process of escape, 20 seconds later, people quickly escape and evacuate successfully. Fig. 1-4 show the relationship between escape time and number of people and exit speed:

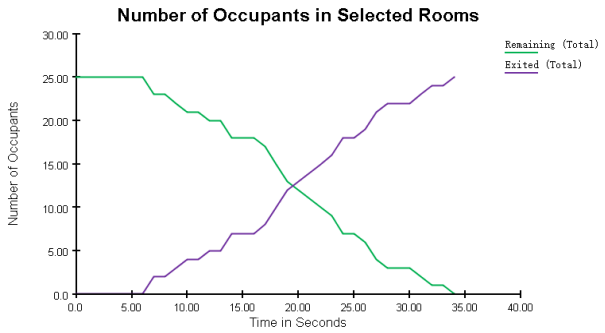

Figure 1 Distribution of number and time of escape personnel in sfpe mode

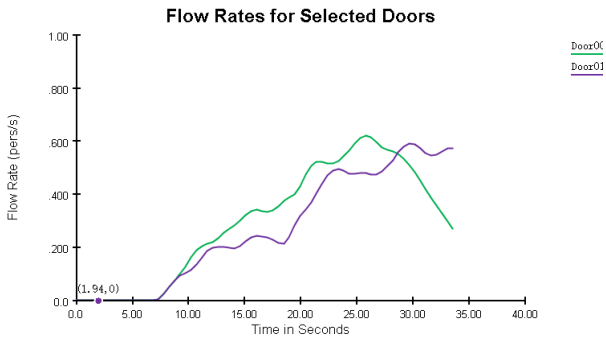

Figure 2 Evacuation efficiency diagram of exit escape under sfpe mode

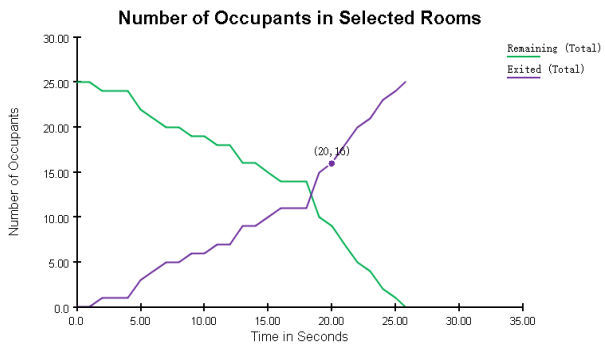

Figure 3 Distribution of number and escape time of escape personnel in sterling mode

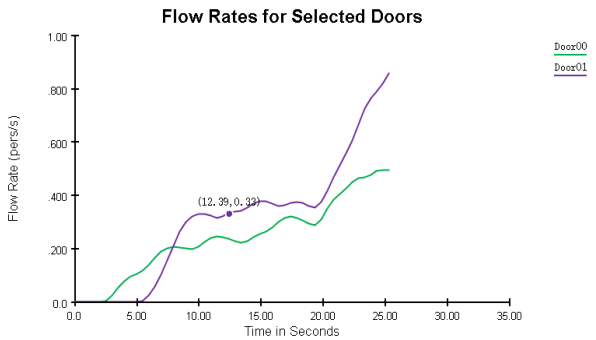

Figure 4 Evacuation efficiency diagram of exit escape under Sterling mode

c) Speed of support group

In the help group, the escape behavior of kindergarten children is the result of interaction with the help of teachers. Therefore, even if the value of *Pathfinder* used for adult evacuation is the horizontal free walking speed of adults, when the software is used for kindergarten evacuation, it should also be studied as a group when children and teachers escape. The walking speed of children was set as 0.4m/s, 0.76m/s and 1.05m/s respectively. In the simulation, the average height of children is 1.07m, the average shoulder width is 0.28m, most teachers are female, the average height of teachers is 1.65m, the average shoulder width is 0.36m. Considering the physiological and psychological characteristics of children, when an emergency occurs, the teacher should guide the evacuation, so the walking speed of teachers in the model is set to be the same as that of children. The values of relevant parameters in three cases are shown in Table 2 , Table 3 and Fig. 5-7.

TABLE 2 THE VALUE OF RELEVANT PARAMETERS IN THREE CASES

Evacuation situation	*Height of children (m)*	*Children's shoulder width (m)*	*Teacher's shoulder width (m)*	*Pairing speed (M / s)*
1	1.07	0.28	0.36	0.4
2	1.07	0.28	0.36	0.76
3	1.07	0.28	0.36	1.05

TABLE 3 EXIT EVACUATION TIME

Evacuation situation	*Pairing speed (M / s)*	*Exit width (m)*	*Time (s)*
1	0.4	1.5	31.3
2	0.76	1.5	17.3
3	1.05	1.5	13.0

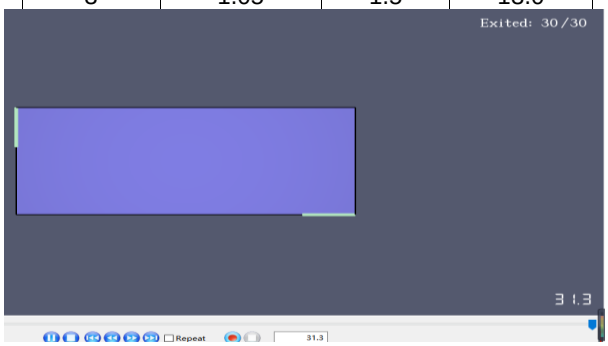

Figure 5 Case 1 time required for evacuation

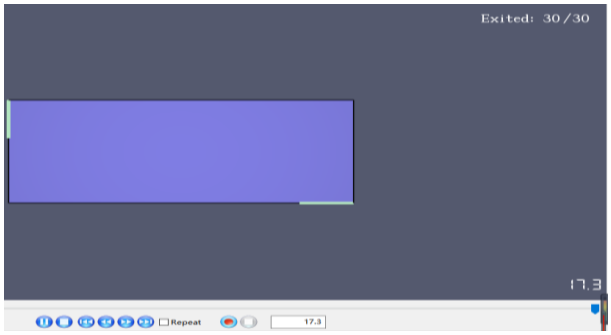

Figure 6 Case2 time required for evacuation

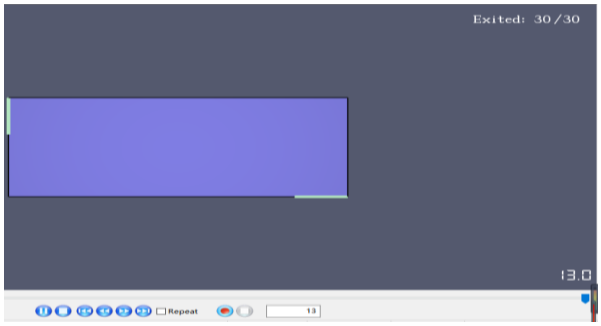

Figure 7 Case3 time required for evacuation

According to the simulation, the escape speed of children is 0.4m/s when the longest evacuation time is 31.3s, and 1.05m/s when the shortest evacuation time is 13.0s. The relationship between the cumulative number of evacuation and the time is basically linear, and the faster the children walk, the larger the slope of the relationship curve between the cumulative number of evacuation and the time, indicating that the faster the evacuation speed of the exit, the shorter the evacuation time.

d) Key points in simulation

Through the research on the evacuation behavior of helping small groups in the process of evacuation, the following points are obtained:

- The higher the height difference between teachers and children is, the faster the escape speed. There was no significant relationship between the speed of escape and the gender of teachers. Different body measurements, signal response speed and escape speed of children will lead to different simulation results.
- The position of individual children in the accident affects the escape efficiency, and the composition of the help group and the position of the individual in the accident have little influence on the overall escape efficiency. However, with the increase of the number of help groups, the congestion at the exit is serious and the safety escape efficiency is low.
- In the process of evacuation, there are the phenomena of avoiding and helping groups and changing escape routes.
- The safe escape time trest depends to a large extent on the response time of the personnel. Because of the incomplete development of children's psychophysiological characteristics, it is very likely that children's individual may affect the escape rate due to the external information stimulation or panic stagnation caused by individual psychological factors during the safe escape process. Therefore, to improve the safety escape rate of children, kindergartens should plan to carry out regular teaching activities and appropriate forms of safety education courses, cultivate children's emergency and escape ability, and form the habit of following the instruction of teachers during the escape process. Meanwhile, teachers should also carry out safety training and education regularly so that they can have the confidence to escape children efficiently and quickly during the escape process.

e) conclusion

Through literature review and questionnaire, this paper studies the safety problems of children's emergency evacuation based on *Pathfinder* in China, analyzes the current situation of safety problems of children's emergency evacuation in China and the measures to optimize the Countermeasures of children's emergency evacuation, and simulates children's emergency evacuation symmetrically through *Pathfinder*. This paper analyzes the influence of different factors on children's emergency evacuation safety behavior and escape efficiency, and designs a set of children's emergency evacuation assistance scheme based on *Pathfinder*. The specific research contents of this paper are as follows: through the combination of data collection and digital simulation, we will study how to plan children's escape routes and escape methods in the process of escape and evacuation, which is more convenient and efficient, and conduct research, investigation and experiment on children's individual behavior response in the process of simulation, By consulting the relevant literature at home and abroad, this paper analyzes the shortcomings of the previous children's escape planning scheme, and finally establishes a more effective children's escape scheme according to the psychological and behavioral characteristics of children, and verifies the feasibility of the scheme.

However, due to many uncertain factors, in the process of escape, the influence of the help group form of teachers and children on the results of safe evacuation and the children's escape planning scheme need more

simulation and practical exercises to support, which is a long-term research. Due to my limited time and ability, there are still some deficiencies in the study of evacuation results in the form of support group, and the data and scheme need to be further optimized and upgraded.

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