An Analysis of the Application of Reflective Materials in Traffic Safety Clothing for Primary School Students

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Abstract: Primary school students are particularly a vulnerable group in road traffic because of their height and mental immaturity. This paper analyses the design process of one type of traffic safety clothing that meets the physical and psychological needs of children through summarizing the traffic behaviours of primary school students. Through the analysis of the coverage percentage of reflective materials, this design can improve the probability for primary school students to be seen by drivers, increase the time span for drivers to make responses, reduce the traffic accidents and unnecessary injuries of primary school students, and provide relevant suggestions for such kind of practical fashion design.

1. Introduction

The road safety of primary school students has always been a social issue that has received widespread attention. In addition to the road safety education of primary school students, “Let Me See You” has become a prerequisite for safe and courteous behaviours of motor vehicle drivers, which requires the increase of their attention to this special group of people. Primary school students are active most of the time and they lack the ability to evaluate the traffic conditions and notice the potential safety problems. Therefore, improving the probability for primary school students to be seen by drivers through increasing the level of visibility and drivers’ stopping distances can enable motor vehicle drivers to make correct judgments in advance and reduce the probability of traffic accidents.

2. Analysis of Traffic Behaviours of Primary School Students

Primary school students are in a period of physical development; therefore, they possess the common characteristics of being short and active most of the time [1]. Primary school students are too young to make proper evaluations about the potential traffic risks, so they usually have some arbitrary, uncertain, and sudden behaviours or actions [2]. At the beginning of this design practice, a questionnaire was made to investigate the walking habits of primary school students and the design of this kind of traffic safety clothing. The main respondents of this questionnaire are parents of the third and fourth grade primary school students. Online research and field research form the data collection part of this research. A total of 300 questionnaires were distributed, and 300 valid questionnaires were recovered.

2.1 Personal Factors

In the questionnaire, the traffic behaviour of primary school students was first investigated. For the question “will the student check the traffic conditions when crossing the road”, 54.78% of the parents chose to check the vehicles on the road every time they cross the road. 41.74% of the parents chose to do so sometimes, and 3.48% would never pay attention to the road traffic conditions.

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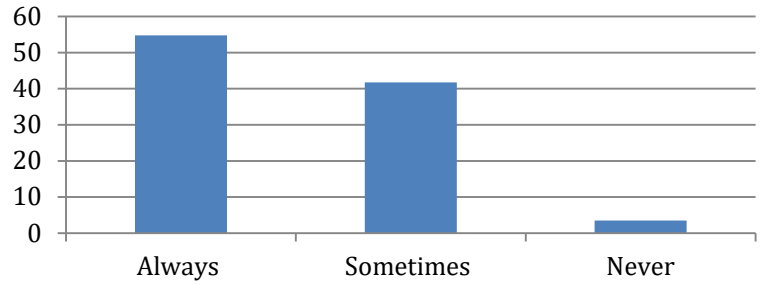

Figure 1 Check the Road Conditions When Crossing the Road

For another question in the questionnaire, "will children concentrate on their walking and not play with others when crossing the sidewalk", 36.52% of the parents responded that their children were able to concentrate on their walking. 54.78% of the parents believed that their children would be distracted sometimes and 8.7% of them said that their children would often be distracted and play games with their classmates or friends on the road.

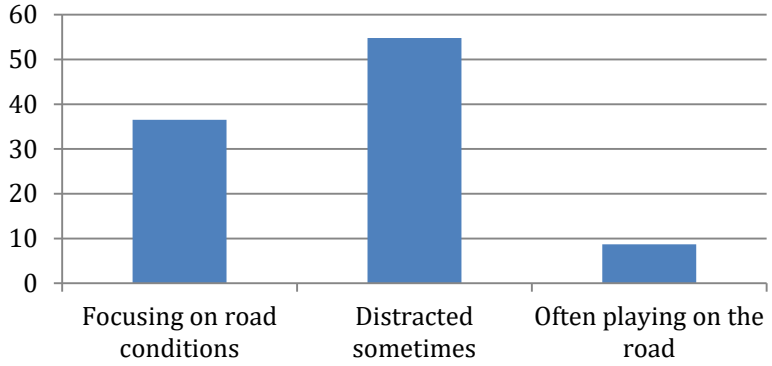

Figure 2 Being Alert When Walking and Crossing the Road

From the results of these questions in the questionnaire, it can be seen that most primary school students will pay attention to road traffic safety when they are walking on the road by themselves after receiving the traffic safety training from their teachers and parents. However, due to their age-specific characteristics such as being energetic and active most of the time, there will always some primary school students who forget to check the road conditions. Most drivers are afraid of the road emergencies concerning primary school students since it is rather difficult for them to make quick and correct responses when children suddenly appear on the road. Therefore, it is crucial to increase the visibility of primary school students' traffic safety clothing and reduce the time for drivers to make proper responses and avoid unnecessary accidents and injuries.

2.2 Other Factors

Home and school education is the main sources of primary school students' knowledge of road traffic safety. Among them, family education is the most influential part for children to foster the sense of road safety. In the questionnaire, 99.13% of the respondents had positive answers to the question "Have you ever taught your children to pay attention to road safety and obey traffic rules?" It indicates that almost all parents will teach their children rules about road traffic safety. But actually primary school students' traffic behaviours are greatly influenced by adults and it is an important source of children's traffic behaviours [3].

3. Analysis of Traffic Safety Clothing Design for Primary School Students

For one statement in the questionnaire "parents' views on the most important elements of traffic safety clothing design for primary school students", 49.57% of the parents chose simple and practical styles. 38.26% of them chose better visibility at night and 6.09% of them preferred the variety of styles and cute patterns. Also, 6.09% of parents were of the idea that the clothing would

change according to the height of the child. From the above analysis, it can be concluded that parents pay more attention to the practicality of clothing and the functionality of safety protection. Therefore, this design focuses on these two key design elements.

3.1 Colour Design Analysis

This design takes the third grade primary school students as an example. Their figures are relatively short and they usually have unexpected movements when walking on the road. In view of these characteristics, the colour selection of the traffic safety clothing is of great importance.

Different colours have different visual effects on the drivers. Based on the relevant theories of the influence of colour wavelength changes on visual adjustment [4], the warning effect of yellow is much better; therefore, yellow is the common warning colour used in our lives. Yellow also has a better warning effect at a long distance. However, if it is too bright, yellow will produce a stimulating visual effect on people's eyes when it is viewed at a short range for a long time, which is not conducive to the safety of road traffic during the long walk for both the wearers and other pedestrians. The wearers of such clothing will also experience the visual fatigue caused by the light reflected by the clothes they are wearing. Thus, it is not suitable to use yellow as the warning colour for a long time and at a short distance.

The visual effect caused by the wavelength of green can make people feel a sense of distance, so the fluorescent green created with the combination of green and yellow. Fluorescent materials can absorb the high-frequency short-wave light from the light source, and convert it into low-frequency long-wave light energy immediately through the change of the electronic energy level and release it. Fluorescent materials are bright and very eye-catching. Compared with other fluorescent colours, fluorescent green has greatly increased the visibility at a long distance, and it is less irritating to the eyes at a short distance. Therefore, it is more suitable for the application of this colour in primary school students' traffic safety clothing, which can fully demonstrate the lively and energetic characteristics of children.

3.2 Pattern Design to Enhance Recognition

Traffic safety warning clothing mainly adopts the reflective strips in order to improve the visibility at night. Similarly, children's traffic safety clothing usually imitates the simple and popular reflective safety vest for adults, which is not attractive to children. The fact is that parents have fewer choices in choosing this kind of traffic safety clothing for their children, so they only wear it on special occasions or for particular uses. Considering these factors, this design aims to express the care of fashion design for children, highlight children's lively and energetic characteristics, and adopt a special design pattern full of youthful features. This is an innovation compared with current children's traffic safety clothing.

Through the analysis of the current situation in traffic safety clothing for primary school students, this design selects balloons and rainbows as the main patterns to demonstrate primary school students' innocence, and a simplified geometric shape design is carried out to make the lines and dots of the pattern stand out from the simple silhouette of clothing. In order to improve the probability for the children to be seen by the drivers, extra patterns echoing the patterns on the body part of the clothes is added to the central position of the clothing sleeve, which increases the visibility in various situations like walking or from the side view. Different patterns can be adopted according to different grades of primary school. Bright colours and simple pattern design can enable the wearer to enhance recognition level among the crowd (Figure 3, 4).

Fig.3 Traffic Safety Clothing Sketch (Balloon Pattern)

Fig.4 Traffic Safety Clothing Sketch (Rainbow Pattern)

4. Analysis of the Application of Reflective Materials

Primary school students are active, energetic and apt to perform sudden and unexpected actions. The younger the students are, the lower ability they have to predict potential hazards. These children's reckless behaviours may put themselves and the drivers in dangerous situation. Therefore, letting the driver see these students at a long distance can better guarantee the safety of primary school students. The use of fluorescent yellow-green improves the visibility of the wearers during the daytime. Special materials are needed to improve the visibility at night.

Both luminescent materials and reflective materials can improve the visibility at night. Common luminous materials with high cost performance include LED lamps, cold light strips, etc. Luminous materials need to be supported by power supply equipment and control switches, which are difficult for young primary school students to manipulate. In addition, young students may find luminous materials interesting and they will sometimes be distracted from road traffic and traffic accidents may happen. Therefore, as a material to improve the visibility at night, reflective materials are more suitable for traffic safety clothing for primary school students. The traffic safety clothing for primary school students used in this design is the reflective material. In view of the characteristics of the children's height and the fewer visual areas of their clothes, the pattern area of reflective materials is designed as follows.

4.1 Standards for Using Reflective Materials

The national standard GB/T 28468-2012 "Reflective School Uniform for Traffic Safety of Primary and Middle School Students" drafted by the Traffic Management Corps of the Public Security Department of Inner Mongolia Autonomous Region and Zhejiang Daoming Optics and Chemical Co., Ltd. was officially promulgated by the General Administration of Quality Supervision, Inspection and Quarantine on June 29, 2012 and it came into effect on December 1,

2012. The implementation of the standard has standardized the production, testing and use of reflective school uniforms, giving due play to its safety protection, and provided a standardized basis for the research and development and innovation of reflective materials related to clothing and supplies for primary and middle school students [5].

4.2 Standards for Using Reflective Materials

Reflective materials are widely used in general protective clothing as special materials to improve visibility at night. In standard protective clothing, there are specific requirements for the use of reflective materials. According to the requirements and specifications of high-visibility clothing listed in international standard ISO20471: 2013, warning clothing is divided into three levels, and the minimum use area of reflective materials from the first level to the third level is not less than 0.1, 0.13, and 0.2 per square meter [6]. It also provides the guidance for the use of reflective materials in non-professional warning clothing --- traffic safety clothing for primary school students.

Previous studies show that under different conditions, the use of reflective materials in fashion design has to follow the following requirements and practical applications. Firstly, the reflective material strip should be no less than five centimetres wide, and two horizontal strips of less than five centimetres are put on the trunk part. Secondly, the strips of the reflective material should not be less than three centimetres wide. Thirdly, there should be a part of reflective material connecting the front and back of the vest and the shoulders of the vest. Finally, the lowest strip of the reflective strips on the trunk part is not less than five centimetres from the bottom of the clothes [7-9].

Table 1 the Application of Common Reflective Materials

Style	Reflective Materials	Width of Reflective Materials
Jacket	Trunk	⩾5cm, two strips
Vest	Trunk, shoulder	⩾5cm
Bandage		⩾3cm

Based on the above requirements for the use of reflective materials for adult protection clothing, the area of reflective materials used in clothing accounts for approximately 10% to 15% of the total surface area. This design serves the young primary school students and the area of their clothes is smaller than that of the adults. Therefore, the design is centralized and repeated to enhance the visual effect of the reflective material. Considering the aesthetic factors, the balloon pattern is used in three parts. The width of the rainbow bar is 4.5-5 cm. Unified patterns are used on the sleeves and the main body part. Reflective material is added at the cuff. All these details can help to improve the visibility when the wearers are seen from both sides (Figure 5). It is estimated that the use of reflective materials for traffic safety clothing of primary school students accounts for about 20% to 30% of the overall area of the clothing. This high proportion of the visible areas at night makes up for the shortage of children's height, so that the wearer can be seen by the drivers easily.

Fig.5 Application of Reflective Materials in This Design

5. Conclusion

As a non-professional warning clothing, traffic safety clothing for primary school students integrates the drivers' habits of making visual judgments with the characteristics of primary school students in colour and pattern design. Through analysing the particular positions of applying reflective materials, this design fully considers children's height and smaller surface areas of their clothes, improves the visibility of primary school students in road traffic, and provides the drivers with more favourable conditions to see primary school students and make judgments in advance.

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