”Red Cars are Faster than Other Cars”: The Impact of Color on Children’s Estimation of Speed

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***Abstract*—Estimation of speed is a major problem for young pedestrians to make the decision about when and where it is safe to cross the road. If some authors concentrated on visual exploration of young pedestrians during crossing activity, no studies have looked at the impact of vehicle color on the estimation of speed by children. Our experiment, conducted with 67 children aged 7, is aiming to investigate the impact of four environmental factors (type of object, speed of the objects, direction of the objects, color of the objects) on the estimation of the speed of moving objects by children. Results have mainly shown that, if direction of the objects has no impact of estimation of speed, red objects (cubes or cars) are significantly perceived as the fastest. Moreover, when the objects are cars, the number of ”Red” responses is significantly superior than ”Blue” responses. And finally, for our participants, red objects are significantly perceived as being faster, especially if they are cars and the speed of movement is fast. Rather than thinking of pedestrian safety as a body of knowledge to absorb, it is most useful to characterize it as a series of cognitive, perceptual, and motor skills that must be mastered to navigate in the traffic environment.**

***Keywords*—Child; Pedestrian; Safety; Risk; Hazard**

I. INTRODUCTION

Pedestrian trauma represents a significant proportion of all road traumas, young pedestrian being over-represented in all these road traumas. In particular, the safety of child pedestrians is of concern, given that a sizable proportion of pedestrians killed and seriously injured involve children and the special value society places on its youth [1] [2]. Because children’s adaptation to an oncoming vehicle’s distance and speed is a critical component of their street-crossing decision-making, several authors investigated how children experience the speed of vehicles when they must to cross a street [3][4]. If all these studies provide very interesting results demonstrating that children’s behaviors are affected by many factors, no study has investigated the impact of colors for different children’s age groups while some authors recognized that colors can be determinant [5].

It is the reason why this paper is aiming to investigate the impact of the red color of vehicle on decision taking and evaluation made by young pedestrians.

A. Context

Around the world, the number of pedestrians killed increase. Young pedestrians are particularly concerned by these accidents: For instance, according to the official data issued from the Traffic Safety Facts, on average, three children were killed and an estimated 502 children were injured every day in the U.S. in traffic crashes. In 2019 and 2020, there were respectively 181 and 177 children killed in pedestrian accidents. In the same way, in France, in 2022, the number of serious injuries for young pedestrians is estimated to be 5 percents higher than in 2019. Most were toddlers (between the ages of 1-3) and young children (4-7). In fact, an estimated 1 in 5 children killed in car accidents were pedestrians, i.e., just walking on the sidewalk or crossing a street whatever the country [6][7].

At ages 6-10 years, children are at highest risk of pedestrian collision [2], most likely due to the beginning of independent unsupervised travel at a time when their road strategies, skills and understanding are not yet fully developed. Whatever the country, research suggests that children between the ages of 6 to 10 are at highest risk of death and injury, with an estimated minimum four times the risk of collision compared to adult pedestrians [8]. Until the age of 6-7 years, children are under active adult supervision, i.e., parents hold their child’s hand when crossing roads together. Even if every year many pedestrians are injured or killed in traffic accidents in rural parts of the country [9], pedestrian safety is being considered as a serious traffic safety problem in urban and suburban settings [10][11]. Thus, children more than adults, are at risk as pedestrians, often due to their own actions and behaviors. So, the question is: “Why do young pedestrians not adopt safety behaviors specially during street crossing?”

From a cognitive point of view, road crossing ability is a high and complex mental activity because the individual has to process dynamic and complex information from his/her surrounding environment, to make a decision, *i.e.*, where and how to cross [12][13]. Some objects automatically attract attention away from other objects in the visual field [14]. Successful crossing performance also requires reliable estimation of the pedestrian’s walking speed, peak capabilities, and distance to the other side of the road or a traffic island. Integrating all these aspects is difficult for the child, especially one inexperienced in traffic, and result in a longer decision making time: In fact, a 5 year old child requires about twice as long to reach a pedestrian decision as an adult.’and This leaves even less time to execute an imperfectly planned crossing [12][13][15]. A vast amount of research suggests that children’s development of cognitive skills is significantly related to increased pedestrian safety and that relevant skills improve as children get older [16][17].

Several studies showed that estimation of speed and assessment of inter-vehicular gap by young pedestrians are two major problems for young pedestrians to make the decision about when and where it is safe to cross the road [18][19][20] [21]. But, if some authors concentrated on visual exploration of young pedestrians during crossing activity [22][23], no studies have looked at the impact of vehicle color on the estimation of speed by children.

B. Are Red Car Faster than Other ?

From a statistical point of view, some data revealed that certain colored cars are more likely than others to be involved in an accident because physical explanations exist. For instance, darker colors make it harder for vehicles to be seen, especially at night, as they blend more into their surroundings, while white cars are highly visible. The belief that red cars are faster is a persistent automotive myth rooted in psychological associations rather than factual evidence. While red cars may appear more dynamic and exciting, their color does not directly influence their speed or performance.

From a psychological point of view, we can distinguish four hypotheses to explain that red cars can be perceived as faster than other cars:

- Based on the probabilistic approach, the preferred color by buyers of fastest cars is red. For instance, as Figure 1 shows, more than 30% of Lamborghini are red. So the probability to see a red Lamborghini is objectively higher to see a Lamborghini with another color. In the same way, about 45% of the cars that Ferrari sells is ordered in red. On this basis, humans generalize information learned about a subset of a category to the category itself. This cognitive bias is very well-documented specially for children [24] [25];
- Based on the social learning theory elaborated by Albert Bandura, a large number of our behaviors is learned by observing and imitating the behavior, attitudes and emotions of others. ”Learning would be excessively laborious, not to say perilous, if people had only to rely on the effects of their own actions to derive information about what to do. Fortunately, most human behavior is learned through observation and ’modeling”. In the case of vehicles, a series of anime and movies display red cars, these cars being very fast [26];
- Based on ethology, several studies show that red color guide attention towards important objects in nature, in particular for mammals [27]. More precisely, red has a direct and automatic influence on cognitive processes, including attention. It was established that viewing red immediately before or during a motor response increases the response’s strength and velocity, most probably due to the elicitation of fear. This influence is consistent with the emotional evaluation of color as either hospitable or hostile. Fire trucks (and fire machines in general, such as extinguishers) have been painted red since the 1900s. To be distinguishable from the average road user, firehouses across the Country painted their apparatuses red to maximize visibility. In this way, the color red ensured the safety and conspicuity of firefighters and the fire trucks they were responding in. Today, to improve attention, fire trucks are additionally equipped with sirens, lights, and retroreflective markings to signal road users that they are responding to or returning from an emergency;
- Some studies have shown that red is associated with positive emotion for children [28], and Several studies have shown that red is consistently observed to be the children’s favorite color, contrasting with the preference for blue in adults [29] [30] [31]. Based on a series of experiments, the research by Burkitt and colleagues has provided the best controlled evidence that the use of colors in drawings is not arbitrary, but instead reflects emotional associations and preferences for children. In their studies, children were invited to use color for drawings [32] [33] [34] [35] to characterized positive, negative or neutral emotion. Their results showed that children used their favorite colors for positive-related characters, their least favorite ones for negative-related characters, and colors with medium preference for neutral characters.

II. METHOD

Our experiment, conducted with 67 children aged 7, is aiming to investigate the impact of four environmental factors (type of object, speed of the objects, direction of the objects, color of the objects) on the estimation of the speed of moving objects by children.

A. Participants

Sixty-seven French participants were recruited to participate in this study (34 boys and 33 girls; Mean age = 7;3 years-

Figure 1. Some popular red cars in different movies and anime

old, SD = 0.9 months). All children come from the same elementary school located in the mid-town. All participants are French native speakers and the majority (86.4%) lives in urban area. All parents agreed to their children participate. No child has severe visual impairment and no cognitive impairment.

B. Independent and Dependent Variables

We manipulated four independent factors, all being within-subject:

- Type of objects in movement, with two modalities: Cube vs. Car;
- Speed of the objects, with three modalities: Slow, Medium, High. The corresponding selected test speeds are 30 km/h (Slow), 50 km/h (Medium), and 70 km/h (High). These speeds were chosen because, according to the ”Law on Road Traffic Safety” in France, the speed of vehicles in the school zone, in the settlement, is limited to 30 km/h, and outside the settlement to 50 km/h. The permitted speed of vehicles outside the settlement is 70 km/h;
- Direction of the objects, with two modalities: Equal, *i.e.*, going in the same direction vs. Different, *i.e.*, passing each other;
- Color, with two modalities: Blue vs. Red;

Only one dependent factor (measure) is collected: the oral response provided by the participant. Question addressed to children was: *According to you, what was the fastest object (or car)?*”. So each participant could answer ”Blue”, ”Red” or ”I don’t know”. There is no time limit to provide the answer.

We also formulate several control variables to avoid biasing the experiment, such as: Counterbalancing of videos for each participant (to avoid an order effect); Presenting the same videos; No severe cognitive impairments for our participants; No known or proven speech disorders; Correct vision declared (correction for 80% of participants); Data collection during the month of December 2024.

C. Material

We used the software Blender to create our 24 videos (Figure 2) showing objects in movement. Blender is a free, open-source software package dedicated to 3D creation. It is used in many fields, including animation, video games, virtual reality, and architectural visualization. Its popularity is based on its power, flexibility, and active community, which contributes to its continuous improvement. Blender enables all stages of 3D production: modeling, texturing, rigging, animation, rendering, simulation and even video editing. Thanks to its customizable graphical interface, users can adapt the working environment to their needs. Blender’s advanced tools also include features for sculpting, shading and compositing. The operating principle is based on a scene-based organization. A scene contains 3D objects (curves, lights, cameras, etc.) that can be manipulated in a virtual space. These objects can be modified using transformations (translation, rotation, scaling), materials and physical effects.

D. Procedure and Design

The entire experimentation could be done at a desk with the children seated. There were an experimenter (always the same) and one participant in a quiet room located in the school. The room had only desks and chairs without any distractions. The experiment has four steps:

- First, the experiment begins with a brief greeting and oral instruction. The instructions are as follows: “*You are going to see different videos of objects or cars in movement. For each video, simply tell me which car you think is the fastest*”;
- If the participant has no question, two trials are provided. Each participant is instructed to be relaxed and to gaze at the center cross during the interval screen for 5 seconds. After this 5 seconds, one of the videos was shown. The participant was instructed to answer the question orally;
- After these two trials, the experiment can begin effectively. This process was repeated with other videos again and again until the participant saw all 24 videos. Figure 3 shows the protocol used;
- Finally, each participant is thanked and a debriefing takes place to gather the child’s impressions.

Throughout the experiment, participants were allowed to quit if they felt too bad or too stressed to continue.

E. Design and Data Analysis

The overall analysis plan (AP) is given by the following relationship.:

$$AP = S \times Object_2 \times Speed_3 \times Direction_2 \times Color_2$$

F. Ethics

All legal parents of children provided the same informed consent. Moreover, the responsible of the school for children

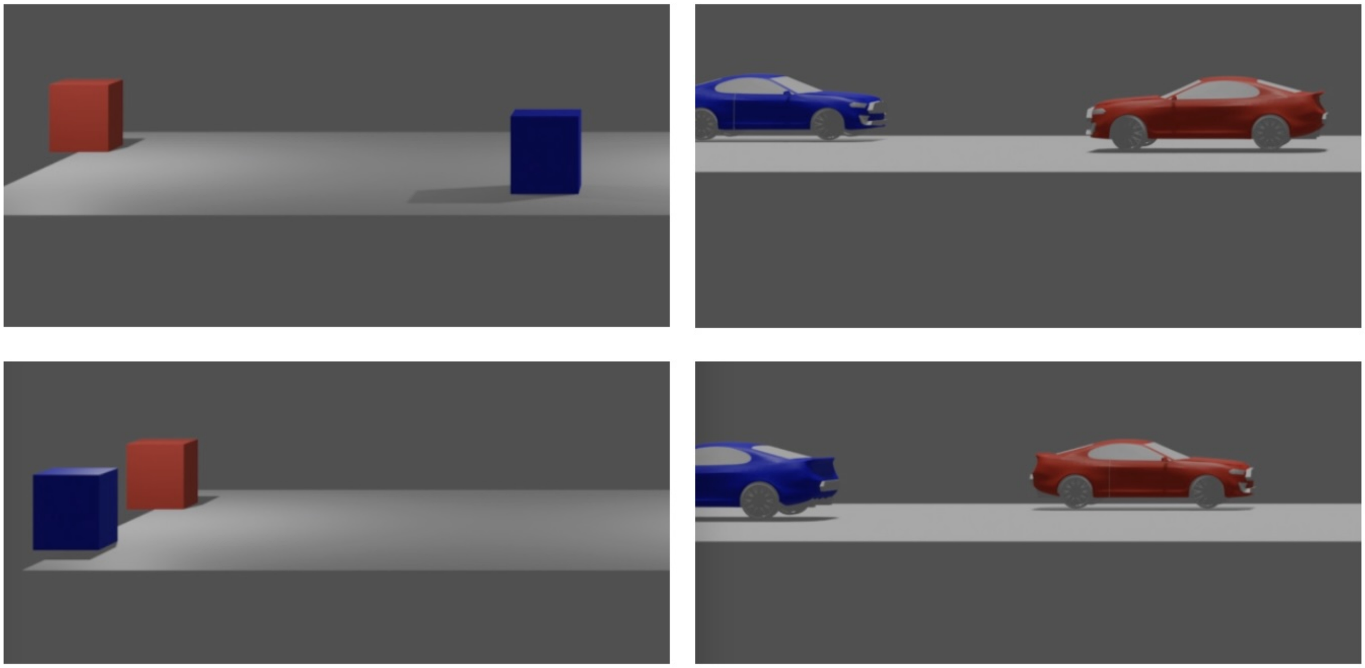

Figure 2. Screenshots of the material displayed on the screen for the experiment

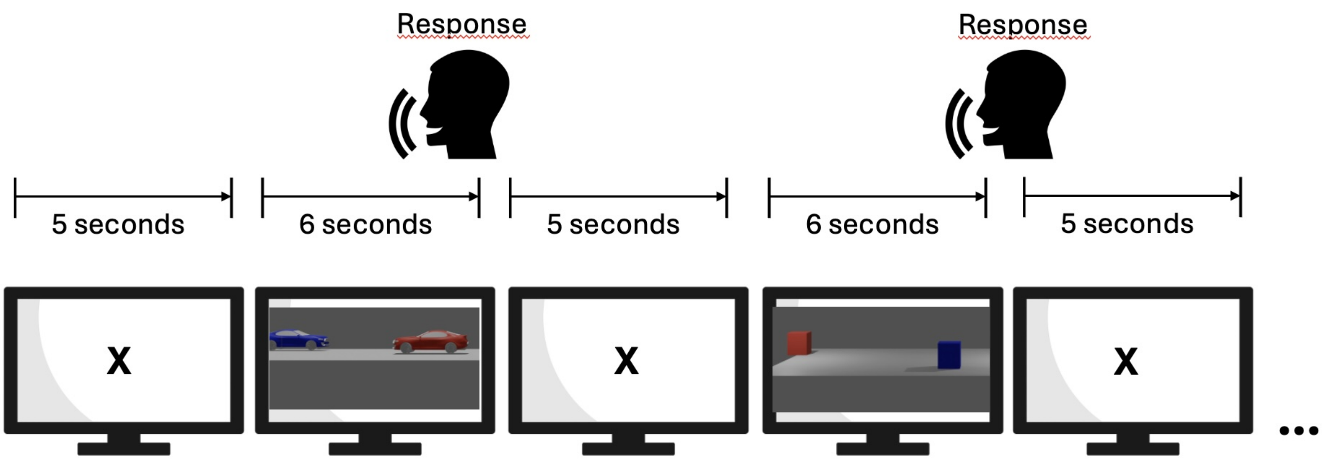

Figure 3. The procedure of the experiment

provided also her consent. All they received the same information relating to the following points:

- A statement that participation is voluntary and that refusal to participate will not result in any consequences or any loss of benefits that the person is otherwise entitled to receive;
- The precise purpose of the research;
- The procedure and material involved in the research;
- Benefits of the research to society and possibly to the individual human subject;
- Length of time the subject is expected to participate
- Researchers ensured that those participating in research will not be caused distress;
- Subjects' right to confidentiality and the right to withdraw from the study at any time without any consequences;
- After the research is over, each of them are able to discuss the procedure and the findings with the psychologist.

III. Results

As Figure 4 shows, several main effects have been obtained:

- To the question, *"According to you, what was the fastest object (or car)?*, 30% of children answered "Red", while only 12.41% answered "Blue". So red objects (cubes or cars) are significantly perceived as the fastest ($\chi^2(1, N = 66) = 17.54$, $p = .001$);

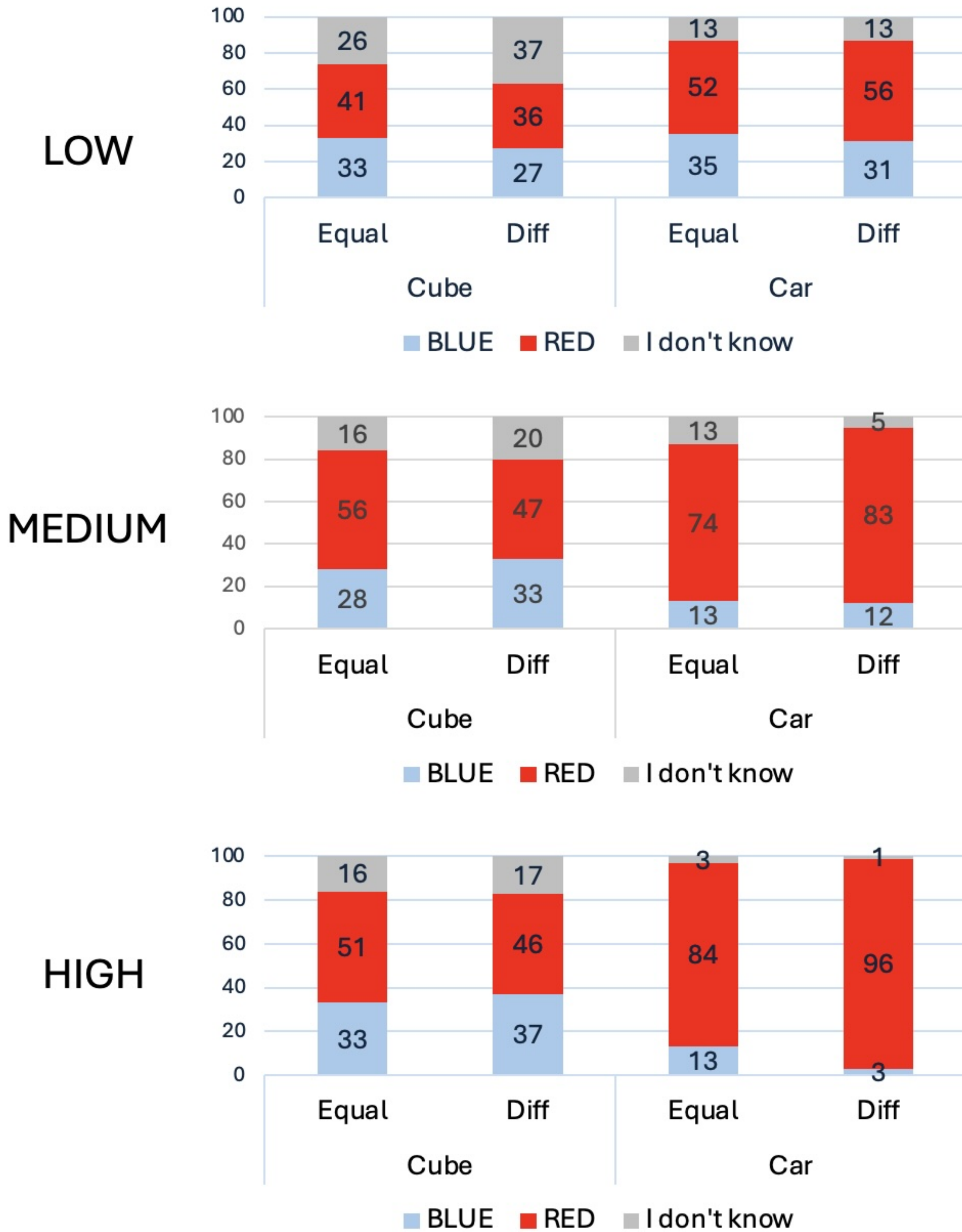

Figure 4. "According to you, what was the fastest object (or car)?" Percentages of responses given by children for the two kinds of objects (Cube vs. Car), for the two senses of direction (Equal vs. Different) and for the three speeds (Low, Medium, High)

- Type of objects in movement (Cube vs. Car) has a significant impact on responses given by children. When the objects are cubes, the number of ”Red” and ”Blue” responses is identical ($\chi^2(1, N = 66) = 6.37, p = .06$). But when the objects are cars, the number of ”Red” responses is significantly superior than ”Blue” responses ($\chi^2(1, N = 66) = 16.68, p = .004$);
- Speed of the objects has a significant impact on responses: (i) For the ”Slow” speed condition (30 km/h), 46.2% of children answered ”Red”, while 31.5% answered ”Blue” ($\chi^2(1, N = 66) = 10.23, p = .03$); (ii) For the ”Medium” speed condition (50 km/h), 65% of children answered ”Red”, while 21.5% answered ”Blue” ($\chi^2(1, N = 66) = 19.37, p = .003$); For the ”High” speed condition (70 km/h), 70.25% of children answered ”Red”, while 20.5% answered ”Blue” ($\chi^2(1, N = 66) = 26.74, p = .001$). In other words, the higher the speed, the more the children respond ”Red”;
- Direction of the objects/cars has no impact on responses given by the children, ($\chi^2(1, N = 66) = 3.21, p = .06$).

To summary, for our participants, red objects are significantly perceived as being faster, especially if they are cars and the speed of movement is fast.

IV. Discussion

Our experiment, conducted with 67 children aged 7, aimed to study the impact of different environmental factors (type of object, speed of the objects, direction of the objects, color of the objects) on the estimation of the speed of moving objects by these children.

If direction of the objects has no impact of estimation performed by the children, the other three factors have a significant impact: Red objects (cubes or cars) are significantly perceived as the fastest; When the objects are cars, the number of ”Red” responses is significantly superior than ”Blue” responses; And the higher the speed, the more the children respond ”Red”. Finally, for our participants, red objects are significantly perceived as being faster, especially if they are cars and the speed of movement is fast.

Several methodological limitations prevent us to generalize the results obtained. For instance, only two colors are used in our videos (red and blue) and there are no decorative elements. So, it could be interesting to reproduce this experiment by adding decorative elements and other vehicles or pedestrians because several studies have shown that the physical and social context are determinant in the behavior of young pedestrians [10][36][37][38].

Nevertheless, our experiment confirms that some environmental factors, such as the color can influence road crossing activity which is a high and complex cognitive activity because the individual has to process dynamic and complex information from his/her surrounding environment, to make a decision, *i.e.*, where and how to cross, especially when these individuals are young pedestrians. Safe pedestrians must possess and utilize advanced cognitive skills [12][13]. Crossing decisions include whether or not to enter the roadway, the place to cross, the path to take, how fast to travel, and how the driver might react. A sound decision on whether to enter the roadway should be based upon recall (experience) and monitoring of the traffic detected, including the distance, speed, and anticipated direction of vehicles and the opportunities provided by various gaps in traffic [39]. The time that has elapsed while making the decision also needs to be incorporated. Successful crossing performance also requires reliable estimation of the pedestrian’s walking speed, peak capabilities, and distance to the other side of the road or a traffic island.

V. Conclusion and Future Works

All individuals, specifically the youngest, must learn how to be a pedestrian. Rather than thinking of pedestrian safety as a body of knowledge to absorb, it is most useful to characterize it as a series of cognitive, perceptual, and motor skills that must be mastered to navigate in the traffic environment. We argue that teaching children how to be safe pedestrians is crucial for their safety and well-being. Learning pedestrian skills, like using crosswalks, looking both ways before crossing the street, and being aware of speed of vehicles, should be introduced at an early age.

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