LOGGING INDUSTRY RESEARCH ORGANISATION
NEW ZEALAND

ISSN 0111-6711

REPORT

Vol. 17 No. 11 1992

CONSPICUOUS COLOURS FOR LOGGERS SAFETY CLOTHING

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Figure 1 - A logger in poor conspicuity conditions

ABSTRACT

In this study the relative conspicuity of several shirts were compared in a laboratory situation. The results showed that fluorescent lime/yellow, white, and fluorescent orange were the most conspicuous colours. The fluorescent lime/yellow shirt was the most highly visible against a pine forest background. It is therefore recommended that if loggers are required to wear high visability clothing, fluorescent lime/yellow is the most appropriate colour for increasing loggers' conspicuity.

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INTRODUCTION

Conspicuity is the ability of an object to quickly catch the human eye's attention. Several fatal and "lost time" accidents and injuries to loggers can be attributed to incidents in which loggers in dark clothing were not seen (poor conspicuity). During 1991, there were ten "not seen" accidents made up of two fatal and eight "lost time" accidents. The lost time accidents had an average time off work of 31.5 days.

Drivers of heavy forestry vehicles (e.g. skidders and loaders) perform a difficult dual task, dividing their attention between a tracking task, i.e. driving a vehicle, and a visual search and recognition task, i.e. scanning the area to locate workmates. Increasing the "conspicuity" of loggers would assist drivers in locating workmates and, in turn, result in a reduction of "not seen" accidents.

The purpose of this study was to test the relative conspicuity of six shirts (Figure 2, A-F). These test shirts comprised three safety shirts (A-C), which have previously been worn in New Zealand and overseas, two shirts (D,E) cited in "Perception" literature as highly conspicuous, and a black shirt (F) as a control.

STUDY METHOD

The experiment was conducted in a Psychology laboratory at the University of Waikato. Twenty-two University psychology students with good eyesight and free of colour blindness, performed an experiment which was designed to simulate the task of driving a forestry vehicle (Bradford, 1992). This involved dividing their attention between a central tracking task (simulation of driving a vehicle) and a peripheral task (simulation of scanning the area to locate workmates).

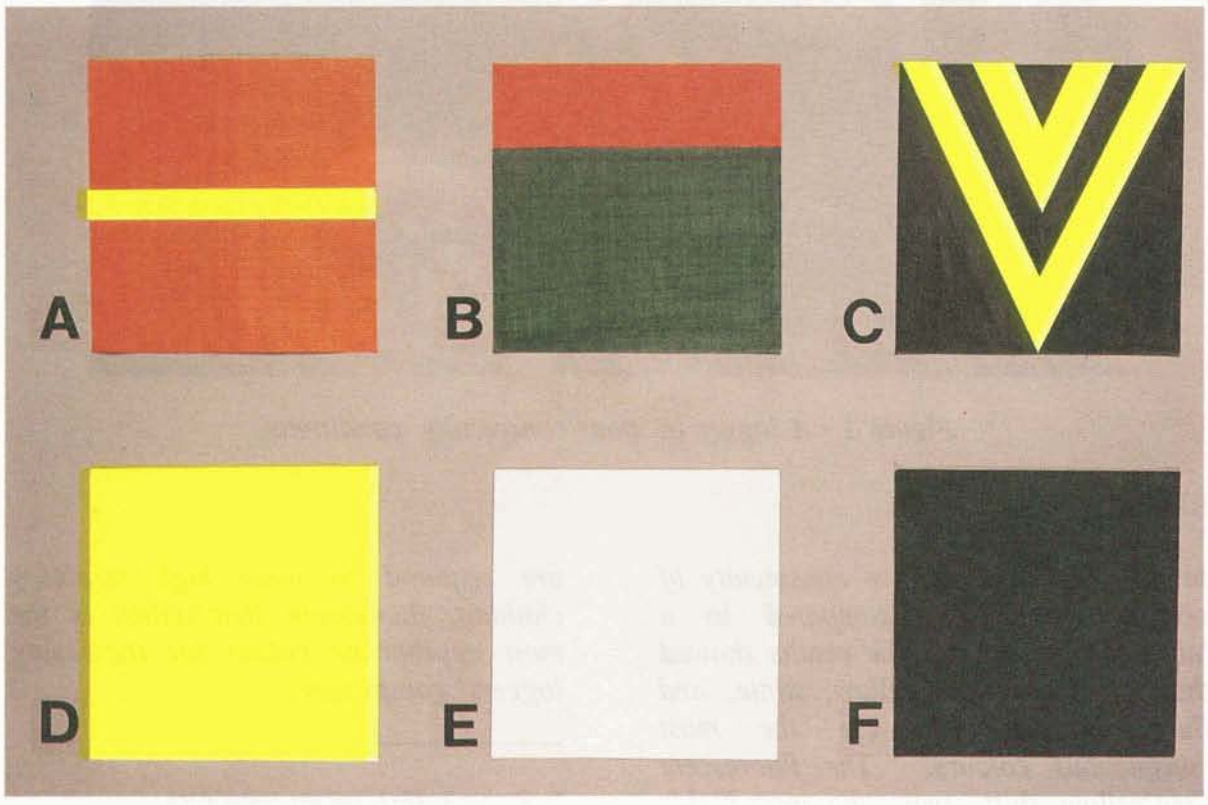

Figure 2 - Experimental test shirts

The central tracking task involved using a joystick to keep a circle over a randomly moving dot on a computer screen. In order to install some degree of urgency into the central tracking task, points were deducted from a starting score every time the moving dot evaded the circle. The person with the highest score at the end of the exercise received a financial reward.

The computer screen was embedded in a slide projector screen on which the peripheral task was projected (Figures 3 and 4). In this peripheral task participants were required to locate the test shirts in slide photographs as the brightness of the slide was gradually increased by the experimenter to simulate different light conditions in a forest.

The test shirts that appeared on the screen were 10 x 10 millimetres in size and were viewed from a distance of two metres. The visual angle subtended by the shirts was therefore approximately 0.3°.

Two series of slide photographs were used in two experimental situations. The first series displayed replicas of the test shirts against a bush camouflage background (Situation 1 - Figure 3) and the second series displayed actual test shirts against a pine forest background (Situation 2 - Figure 4).

Figure 3 - Situation 1 - camouflage backgrounds

Figure 4 - Situation 2 - pine forest background

In both situations, the test shirts were moved through a number of different positions with all shirts eventually appearing in each position. During the experiment, all participants wore an ASL Eye-Tracker 4000 SU (Figure 5).

Figure 5 - The ASL 4000 SU eye tracker

The ASL 4000 SU Eye-Tracker device uses two miniature video cameras; the first records the person's field of view, and the second records the person's eye movements. A computer combines the information from the two cameras and produces a video picture of the person's field of view with a moving cursor superimposed on the scene in the position that the person is looking.

Background	Order of discovery	Test-shirt type					
		Fluro Orange	Red & Green	Fluro Yellow "V"	Fluro Lime/ Yellow	White	Black
Camouflage	First (%)	1	0	1	43	53	1
	Second (%)	9	0	11	44	36	0
Pine forest	First (%)	14	4	5	43	32	1
	Second (%)	38	8	1	23	24	5

Table 1 - Percentage of total trials in which each test shirt was seen either first or second against a camouflage background and a pine forest background

This device allows simultaneous and continuous recording on video tape of what the person is looking at. This method provides detailed measurement and analysis of a person's eye movements and the order in which they locate the test shirts.

RESULTS AND DISCUSSION

The results clearly showed that the fluorescent lime/yellow, white, and fluorescent orange test shirts (A, D, and E - Figure 2) were the most conspicuous in both situations. In the first situation (bush camouflage background), **white** or **fluorescent lime/yellow** were seen first in 96%, and second in 80%, of all trials. In the second situation (pine forest background), they were seen first in 75%, and second in 47%, of all trials (Table 1). The conspicuity of the fluorescent lime/yellow shirt was superior to the white shirt in the pine forest situation where the background contained many bright-dark contrasts. White was the most conspicuous colour against the camouflage background which contained less contrasts. These results confirmed the findings reported in Shuman (1991) that the human eye is most sensitive to hues in the middle of the colour spectrum, between the wavelengths of 510 and 570nm. The wavelength of lime/yellow light falls in the middle of the spectrum of visible light, the scale of colours - red, orange, yellow, green, blue, violet. In very dark environments white is a more visible colour because it provides the highest contrast with dark backgrounds. However, white becomes "washed-out" (blends into the background) when background light is very bright.

The fluorescent orange shirt (shirt A - Figure 2) was more visible in the pine forest situation than against the camouflage background, being seen first in 14%, and second in 38% of trials. All other shirts were seen first in less than 6% of trials in both situations. Fluorescent orange is a commonly used colour for safety clothing in many different environments (e.g. traffic, marine and forestry). However, this study showed that fluorescent orange was clearly less conspicuous than fluorescent lime/yellow.

CONCLUSIONS

Wearing high conspicuity clothing not only increases the logger's chance of being seen by the operators of heavy machinery (i.e. skidders, loaders and haulers), but also by other loggers (i.e. fallers, skidworkers and breakerouts).

While the fluorescent orange colour is commonly used for safety clothing in many different environments (e.g. traffic, marine and forestry), this study showed that fluorescent orange was clearly less conspicuous than fluorescent lime/yellow.

The conspicuity of the fluorescent lime/yellow shirt was superior to the white shirt in the pine forest situation where the background contained many light-dark contrasts.

Forest industry high visibility safety equipment should be coloured fluorescent lime/yellow.

REFERENCES

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