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Effectiveness of Eye-catching Colors on the Hand-eye Coordination Skill

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Hand-Eye 協応技能に関する誘目色の影響

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和文抄録

誘目色は，眼や心に惹きつけられるといった色彩に関係している．我々は誘目色が選択的プロセスを伴うHand-Eye 協応技能を向上させるものと推測した．被験者は体育を専攻している105名の男女学生である．協応課題における装置測定はパソコンシステムが使用された．各試行における色彩パターンは，赤，青，黄，オレンジ，白，黒の6つの指標色で構成された．また青，緑，白，ブラウンが背景色として選ばれた．本実験におけるそれぞれの色彩パターンは，パソコンのモニターで表示された．被験者はあらかじめ決められた指標色を識別し，30秒でできるだけたくさん消去するように指示された．本研究によって，白，青，黄の色彩は誘目性に優れていること，そしてこれら色彩が選択反応を伴う Hand-Eye 協応技能において有意な向上を示すことなどが明らかにされた．誘目色は視知覚的反応においてより敏感で，このような特性は，選択的反応状況を伴う Hand-Eye 協応課題において重要な働きをするものと思われる．

Abstract

Eye-catching color refers to the colors which are attractive and salient to the eye or mind. We hypothesize that eye-catching color improves the perceptual-motor skill of hand-eye coordination in selective process. The subjects were 105 college students of both sexes, majoring in physical education. A personal computer system was used as an apparatus for the measurement of the hand-eye tasks. The visual pattern of colors in each trial consisted of six colored objects, red, blue, yellow, orange, white, and black. Blue, green, white, and brown were selected as background colors. In the experiment, each pattern of colors was displayed on the monitor of the personal computer. Subjects were asked to select a colored object specified in advance and to extinguish it by pressing the button of the mouse as many times as possible within 30 seconds. The findings in this study indicated that the object colors of white, blue and yellow were recognized as eye-catching colors and that these colors significantly improved the hand-eye coordination skill in the selective response. It is therefore

hypothesized that eye-catching colors are more sensitive in the visual perceptual response, and that these characteristics play important roles in the selective function.

Key words: Eye-catching Color, Hand-eye Coordination Skill,

Introduction

Improvement of motor skills in physical education and sports partially concerns the ability to detect the colors of the visual stimuli and to respond quickly and precisely to them. According to previous studies (Issacs, 1980; Kotoh et al., 1985; Nakishian, 1964), color is one factor that is expected to affect visual and perceptual motor skills. In particular, the attractiveness of the colors seem to have differential effects upon the performance of activities requiring psycho-motor and judgmental functions in recognizing and distinguishing the existence of an object and/or an opponent in sport and physical education.

In our previous study (Sugiyama & Iwase, 1994), it was shown that white and yellow among the six object colors were more attractive and salient as eye-catching colors, and that these characteristics of the specific color were recognized by 71% of the subjects. The eye-catching colors were expected to be more sensitive to the visual perception and improve the hand-eye coordination task. However, according to another of our observations (Sugiyama & Iwase, 1996), the effect of these colors was not clear in the hand-eye coordination task with the simple RT process. Considering the characteristics associated with the aspect of attractiveness, these colors should be advantageous in the judgmental situation in which specific color is distinguished and selected. This information may aid in teaching the various skills in motor learning.

In several papers (Morris, 1976; Ridenour, 1979; Issacs, 1980; Belka, 1985) regarding the effect of color in coordination skill, positive steps have been taken to closely examine the factors that may influence the motor task, i.e., the catching of balls by young children. However, it seems that the relationship between these colors and perceptual motor skill is still unclear and that a number of reports quoted upon which we make assumptions about the skill development didn't lead clearly to the same opinion. Moreover, little attention has been paid to perceptual application of eye-catching colors as a possible means of developing the hand-eye coordination skill.

Investigations examining effects of color related to specific perceptual responses by the color of stimuli may further delineate the roles that colored stimuli play in perceptual-motor response. This study is aimed at obtaining a fundamental understanding of the effects of eye-catching colors on hand-eye coordination skill with response-selection.

Method

The subjects were 105 college students of both sexes who were majoring in physical education and life-long sport. None of the subjects had any color weakness and/or blindness.

A personal computer system was used as the apparatus for the measurement of this task. Each subject was positioned before the monitor display and was shown the measurement method of this task. The visual pattern of colors in each trial consisted of six object colors and a background color. White (N9.5), black (N1.0), red (4R 4.5/14), orange (4YR 6.0/12), yellow (9Y 8.5/10.5), and blue (3PB 3.5/12) were selected as object colors. Blue (3PB 5.0/10), green (9GY 6.0/10.5), white (9GY 6.0/10.5), and brown (8YR 5.5/11.5) were selected as background colors. In addition to these definitions of the colors, an example of the pattern of their objects against a background are shown in Figure 1. Each colored object on the monitor screen was displayed at equal intervals from the mouse cursor position in each trial. The combination of the object colors and each background color was assigned randomly and equally for each experimental session.

The hand-eye coordination task consisted of a process that included the display of colored objects, the selection of a specific colored object, hand-controlled movement using a bus mouse, and the extinguishing of the object by the pressing of its button. Each experimental condition used to select the object of the specified color was given 3 trials. The subjects were subjected to 18 trials totally as an experimental session. All the subjects were asked to extinguish a colored object predetermined in advance as many times as possible during 30 seconds. For each trial, the number of times the object

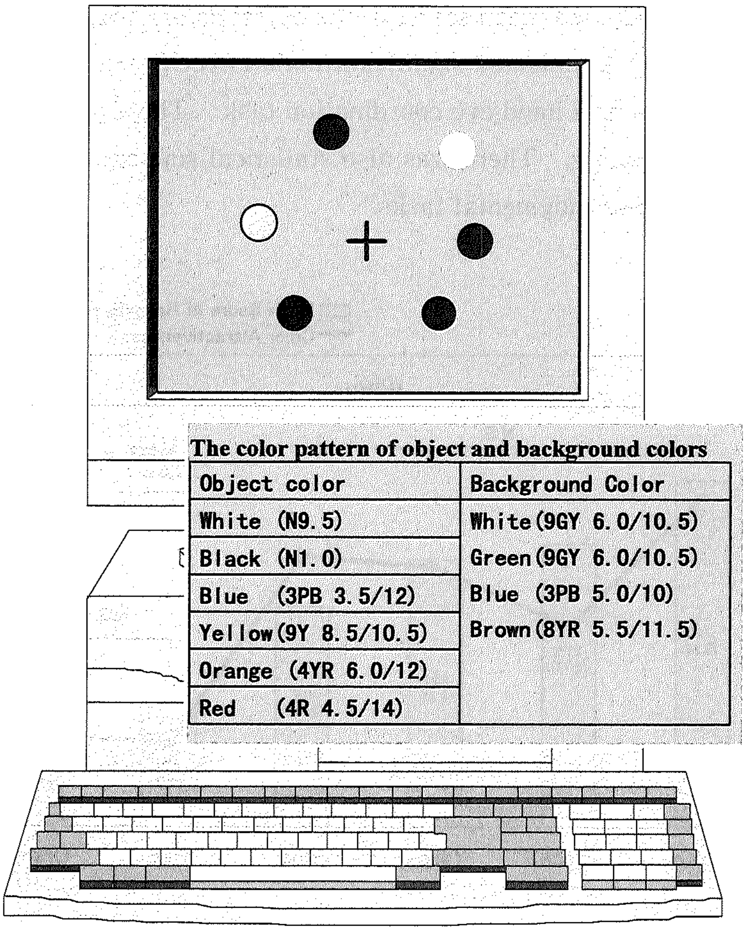

Fig. 1 The object and background colors were defined in this experiment. Six object colors and four background colors were selected as an experimental condition. The display on the monitor screen shows an example of the color pattern of object and background colors

was extinguished was counted. One way analysis of variance (ANOVA) was used for statistical treatment.

After this experiment, all the subjects were asked what color was most attractive, in terms of the eye-catching characteristics among the objects used. The relationship between the eye-catching characteristics and the hand-eye coordination skill was discussed.

Result

The results of the measurement are shown in Figure 2. The stick graph shows the mean of the number of responses needed to extinguish the specific colored object during 30 seconds. These mean scores, under the condition of each object color for white, yellow, black, blue, red, and orange, were 26.2, 25.7, 25.9, 25.4, 24.9, 24.5 respectively. And the line graph shows the frequency of the most attractive color recognized as an eye-catching color for each subject. The result was that the colors of white, yellow and blue were found to be relatively more attractive, whereas the colors of red and orange were less attractive.

As predicted, higher scores were shown in the color conditions which included white and yellow as eye-catching colors. Conversely, the mean scores of the object colors of red and orange were relatively small. Furthermore, ANOVA indicated significant main effect $F=3.84$, $P<0.01$ ($df1=5$, $df2=624$) among the color conditions for this hand-eye coordination task. There was no significant difference among the other four object colors. There was also statistical support for the proposition that the eye-catching color affected these judgmental tasks.

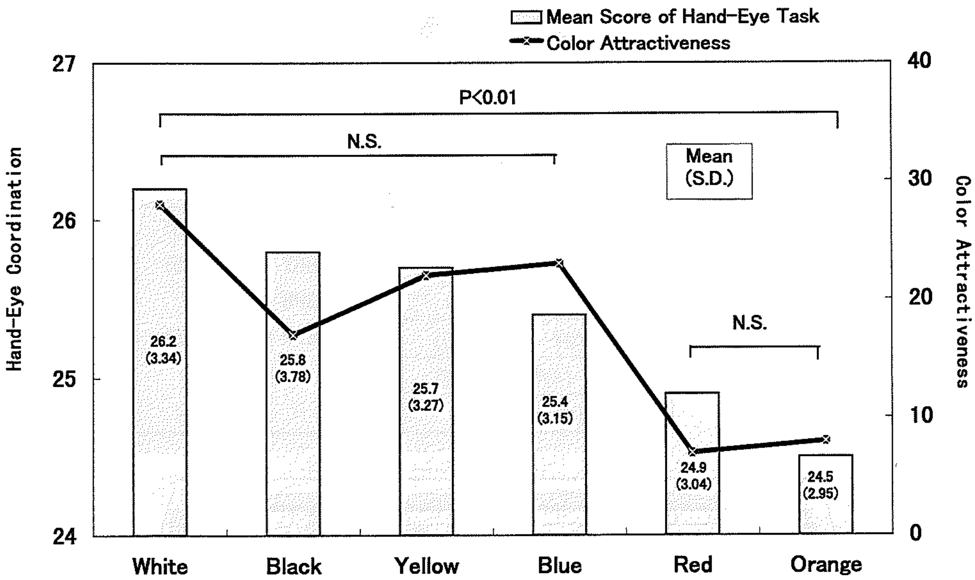

Fig. 2 Mean scores and standard deviations of the number of distinguishing objects recognized during 30 seconds in the hand-eye coordination task are shown by the stick graph. There is a statistical difference among the object color conditions. The line graph presents the frequency of the most attractive color recognized as an eye-catching color by each subject.

Discussion

The human motor system can be thought of as a processor of information, with signals received from the various sense organs, processed through various stages, and with its output as movement (Schmidt, R. A.; 1991). As shown in Figure 3, the expanded information-processing model has three main stages: a stimuli-identification stage, a response-selection stage, and a response-programming stage. The difference between simple and selective process seems to depend upon whether or not, in a high dimensional judgment, such a response-selection exists in the reaction process.

Examining the effect of eye-catching colors under the same color condition, despite having no color effect in the simple process, this finding shows that the eye-catching color effect was very clear in selective hand-eye coordination skill. This means that the eye-catching color signals from the visual sense organs play one of the important roles in their arousal to these processing stages, especially in the response-selection stage. These results should be accounted for by the fact that the level of arousal from the eye-catching colors was high enough to affect response-selection in hand-eye skill. In addition, it becomes clear that white, yellow, and blue are recognized as eye-catching colors, and that red and orange are relatively less attractive. We are quite sure of the effect of the eye-catching colors on the hand-eye coordination skill with response-selection. It is suggested that under this experimen-

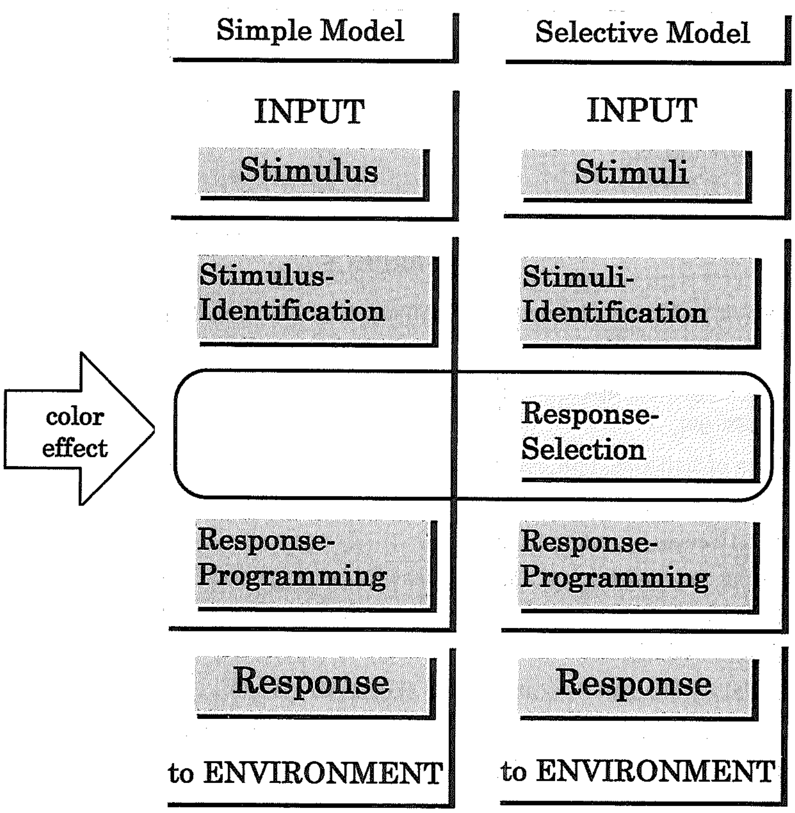

Fig. 3 Two types of information-processing models of human performance. The arrow presents the processing stage which the color affects.

tal condition and measurement, the eye-catching colors, including white or yellow, would be stimuli that are more effective to the perceptual and motor skill in the judgment function.

Psychological literature (Gaines, 1970; Kansaku, 1967; Koslow, 1985) has suggested that specific color may serve as an attentive and attractive cue. It was shown in the report of Pfendler and Widdle (1986) that color has a positive influence on vigilance performance. Also, it is pointed out that the color of the environment has differential effects upon the performance of activities requiring perceptual and judgmental function (Belka, 1985; Luckish, 1918). This body of literature is growing and disseminating knowledge about color basics and recommendations for its use, presenting the possible profit from the use of color. The use of eye-catching colors seems to be a possible means of improving discrimination in perceptual-motor skill performance, and should be suggested in the field of sport and physical education. In fact, these colors, such as white, yellow, and black, are being used as tools in many kinds of sport.

If these findings can be replicated in sports situations, it may have implications for the use of the eye-catching colors. Concerning various color situations in sports and physical education, however, we feel that the data on the color environment is still insufficient, and there is still ample scope for further study of these matters. The relationship between eye-catching characteristics and hand-eye response is extremely still complex, especially in motor skill. Thus, in future investigations, influencing factors such as object size (McCaskill, & Wellman, 1938; Payne, and Koslow, 1981), preferred color (Issacs, 1980), and color contrasts of object and background (Issacs, 1980; Morris, 1976) will be given serious consideration in the hand-eye coordination skill. In addition, considering the situation of sport and physical education, the need to use moving objects should be stressed (Sugiyama, Nozaki, & Mori, 1994), and further study is warranted to take into account these effects in the assessment of the role of color in perceptual motor skills.

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