

Original Paper ~~~~~

## Identification Study of Information on Short-Side Surface of Medical Drug Individual Package Case

Teruyuki YAMAMOTO<sup>\*,\*\*</sup>, Kenichi NEGISHI<sup>\*\*\*</sup>, Ayako FUKUI<sup>\*\*\*</sup>, Kohei MIYASO<sup>\*\*\*\*</sup>,  
Takao AOYAMA<sup>\*\*\*</sup>, and Naoki KAMIMURA<sup>\*\*\*</sup>

The purpose of this research was to clarify the identification of the information on the short-side surface of individual package cases through an experiment from the viewpoint of the prevention of mistakes in picking up medical drugs. Subjects were shown sample sheets depicting the front designs of individual package cases, and they were asked to identify the specified medical drugs from the sample sheets in which the designs on the short-side surface of individual package cases were randomly arranged, which was prepared by imaging the drawers of a dispensing table, and the time required (in seconds) for identifying the specified medical drugs were compared. The times required (in seconds) were significantly shorter in both the pharmacist group and student group when the coloring of the short-side surface was the same as that of the front-side surface. Compared with the cases where the coloring of the short-side surface was not the same as that of front-side surface, the gaze on heat map was more stable. These results suggest that information such as coloring and design on the short-side surface of an individual package case greatly affects the identification of the medical drugs.

Keywords : medical drug individual package case, short-side surface, design, coloring

### 1. Introduction

Recently, the number of medical drugs that pharmacies keep in stock is becoming greater<sup>1,2)</sup>. One of the reasons is considered to be the prevalence of branded generic drugs. According to the results of the special investigation involved in the result verification of the 2016 Revision of the Medical Payment System, the increasing rate of stockpiled items of branded generic drugs was 11.0% (from June 2016 to June 2017)<sup>2)</sup>. According to the 2016 Revision of Dispensing fee, one of the calculation requirements of “Additional Medical Fees for Standard Dispensing” is to “stockpile more than 1,200 items of medical drugs involved in insurance dispensing”<sup>3)</sup>. The “Additional Medical fee for Community Support System” was newly established in place of the “Additional Medical Fees for Standard Dispensing” which was abolished by the 2018 Revised Dispensing fee. It made family pharmacists fulfill their functions and evaluated pharmacies contributing to community-based health care under a community-based integrated care system; there is a similar calculation required for this additional fee<sup>4,5)</sup>. It is considered that these

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<sup>\*</sup>Faculty of Pharmaceutical Sciences, Sanyo-Onoda City University; 1-1-1 Daigakudori, Sanyo-Onoda 756-0884, Japan

<sup>\*\*</sup>Jinjo Pharmacy; 3200-5 Kume, Shunan 745-0801, Japan

<sup>\*\*\*</sup>Faculty of Pharmaceutical Sciences, Tokyo University of Science; 2641 Yamazaki, Noda 278-8510, Japan

<sup>\*\*\*\*</sup>Toyama Sugaki Co.,Ltd.; 23-1,Tsukahara ,Toyama 939-8585,Japan

things together with the prevalence of branded generic drugs became the causes of increasing the stockpile of items in insurance pharmacies. As a result, many pharmacies store medical drugs not only on the shelves above the dispensing table but also have to store them in the drawers of dispensing tables. It is considered that medical drugs stored on the shelves above the dispensing table are in the condition of PTP sheets being taken out from individual package cases or in the condition they are still in individual package cases. However, in many cases, the medical drugs with PTP sheet still in individual package cases are stored in the drawers. Therefore, pharmacists pick up medical drugs in drawers, in particular, by identifying only the design on the short-side surface of individual package cases. Therefore, in this research, the identification of the information of the short-side surface of individual package cases was clarified from the viewpoint of the prevention of mistakes in picking up medical drugs. Comparative experiments were conducted targeting pharmacy students who were the least accustomed to pharmacy services among the qualified students and professional pharmacists in its engagements.

## **2. Methods**

### **2.1 Subjects**

Students Group:

Thirteen students from six grades of Tokyo University of Science, Faculty of Pharmaceutical Science

Pharmacists Group:

Twenty-one pharmacists from Jinjo Pharmacy and its affiliate pharmacies

### **2.2 Device used**

A device for recording eye movement (hereinafter referred to as “eye tracker”):

Tobii Pro Glasses 2® (Tobii Technology)

### **2.3 Identification Experiment**

#### **2.3.1 Comparison of the times required (in seconds) for finding medical drugs by the presence or absence of coloring**

The subjects were shown a sheet depicting the front designs of individual package cases (Fig. 1) and they were asked to find specified medical drugs from two kinds of sample sheets where the designs on the short-side surface of individual package cases were randomly arranged (sample sheet A assuming designs different by each medical drug (Fig. 5), and sample sheet B assuming uniform design of a pharmaceutical company (Fig. 6)), and the times required (in seconds) for finding medical drugs were compared.

Sample sheets were created as follows: As for pharmaceutical agents which begin with “ア”, “a”, 63 items were selected for usage frequency in pharmacies in descending order. On a sheet which represented storage drawers, 1 – 63 location numbers were allocated. The location numbers and the item names of 63 pharmaceutical agents were input to Microsoft Excel and random numbers were generated for agent cells employing the RANDBETWEEN function. Randomized numbers were applied from “1” in ascending order and then, duplicated numbers were randomized using random numbers which were not overlapped. In all experiments, the same sample sheet was used for all participants.

In creating package designs of a short-side surface, we decided the size of the short-side surface as overall dimensions referring to a PTP package of 100 standard tablets, in consultation with TOYAMA SUGAKI Co., Ltd., a manufacture of packaging. Basic designs were employed, where font type, position and size were selected in accordance with general-use packages. Layout of drug names and specifications were chosen with consideration of questionnaire results in our previous research for pharmacists.

Experiment time was measured from a start signal (showing a sample sheet and letting subjects know by voice) until an end signal (subjects told the assigned drug name by voice and pointed to the drug.) The recorded videos were observed by multiple researchers and then, time durations (in seconds) were recorded.

Before the experiment, individuals were informed that “the design on the front surface and that on the short-side surface are not always the same” and two experiments were conducted such as I) looking for the cases with the same coloring on the short-side surface as on the front surface and II) looking for the cases without the same coloring on the short-side surface as on the front side surface.



**Fig. 1** Examples of the designs on the front surface of individual package cases shown to subjects

### 2.3.2 Gaze Analyzing Investigation

The subjects were fitted with an eye tracker, and their gaze trajectories during the experiment were recorded, and at the same time, their ranges of eye movement were analyzed from the heatmap visualized by changing the gaze retention times to the colors from green to yellow to red (short to medium to long time).

## 2.4 Hearing Investigation

After the identification experiment, all subjects were questioned about the order of confirmation of four elements of the designs of individual package cases of sample sheets, such as name of product, specification-small, specification-large and the color band in the lower part. Furthermore, pharmacists were additionally questioned whether they are dispensing drugs while imaging the front surface of individual package cases.

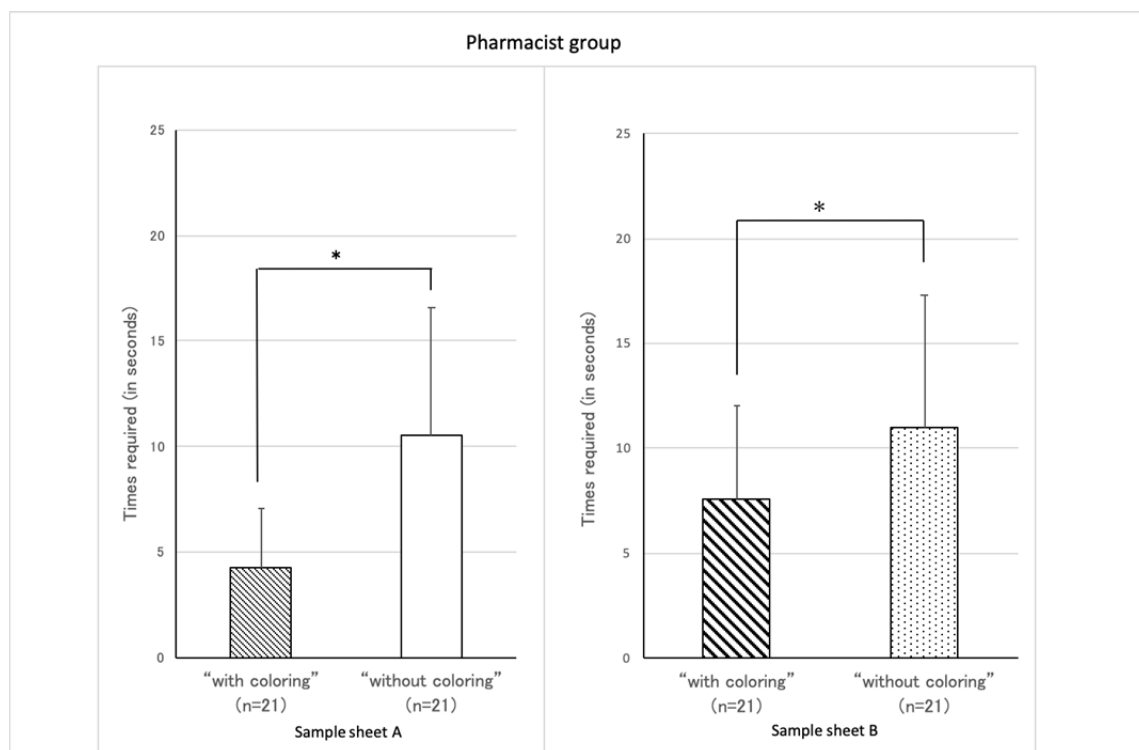
## 2.5 Statistical Analysis

The times required (in seconds) were statistically analyzed by a Student's t-test with a significant difference of  $p < 0.05$ . Excel 2016 for Mac was used as analysis software.

## 3. Results

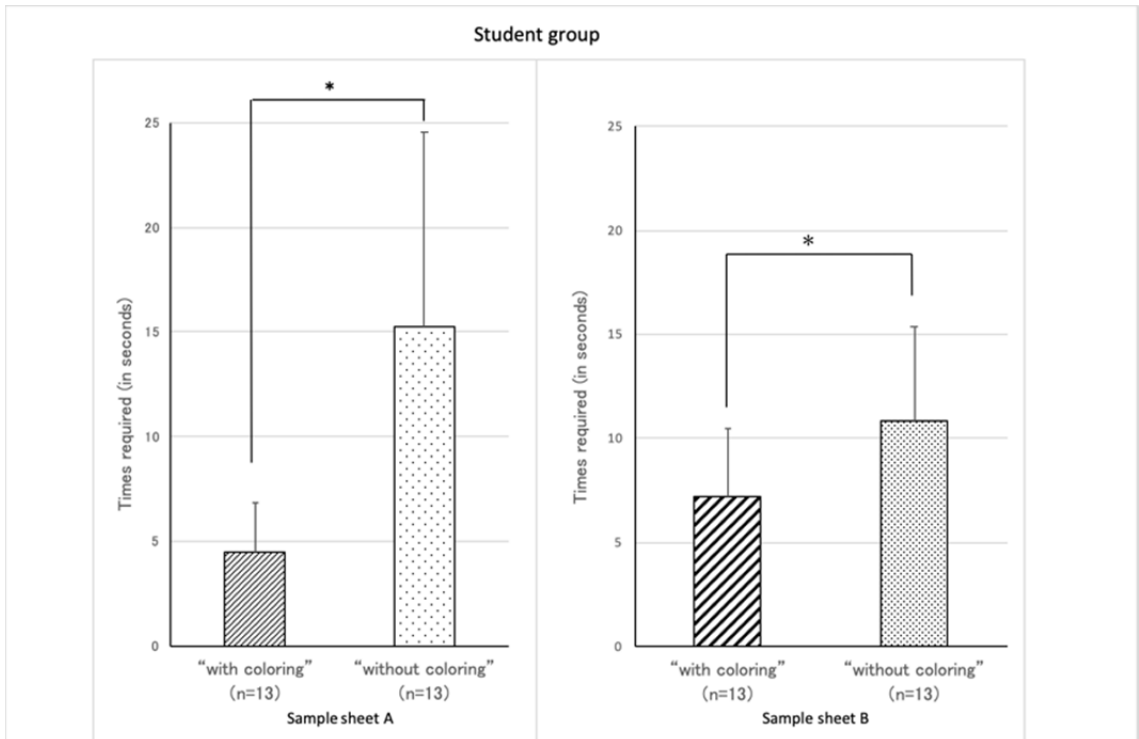
### 3.1 Identification Experiment

#### 3.1.1 Comparison of the times required (in seconds) for finding medical drugs by the presence or absence of coloring



**Fig. 2** Comparison of times required (in seconds) for finding "with coloring" and "without coloring" by the pharmacist group

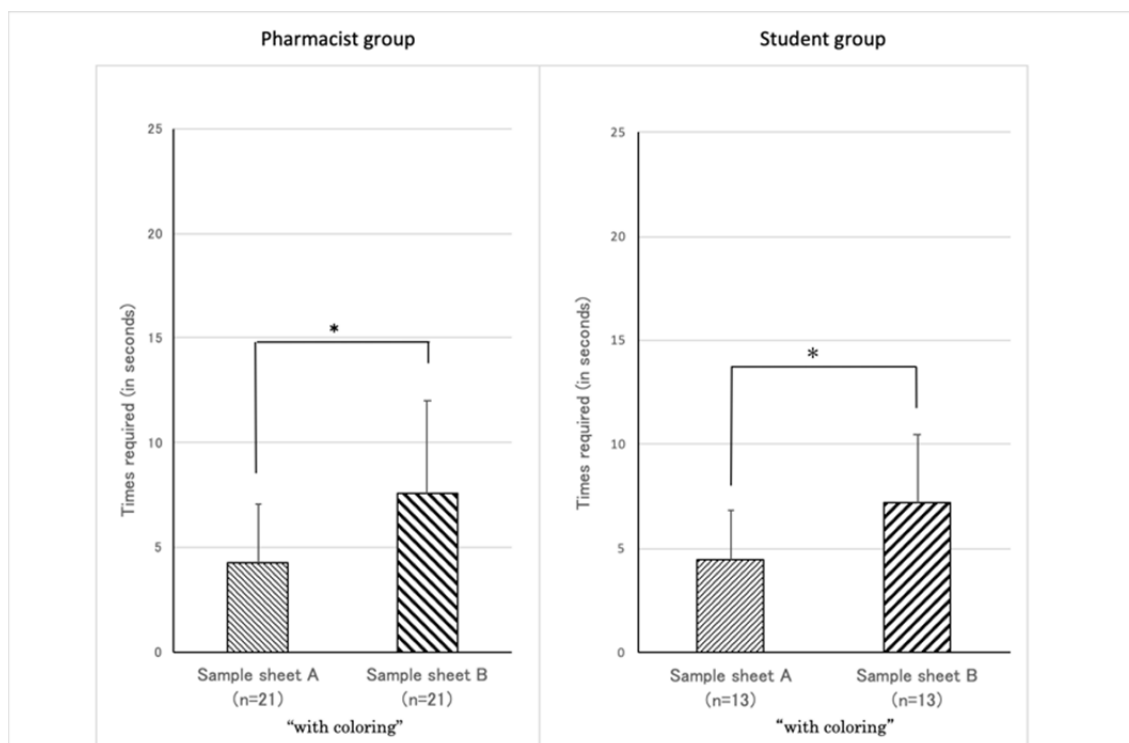
The times required (in seconds) for finding "with coloring" and "without coloring" of sample sheets A and B by the pharmacist group (n = 21) were measured and compared after "average  $\pm$  standard deviation" being calculated. They were analyzed by Student's t-test with a significant difference of  $P < 0.05$  and shown with \*.



**Fig. 3** Comparison of times required (in seconds) for finding “with coloring” and “without coloring” by the student group

The times required (in seconds) for finding “with coloring” and “without coloring” of sample sheets A and B by the student group (n = 13) were measured and compared after “average ± standard deviation” being calculated. They were analyzed by Student’s t-test with a significant difference of  $P < 0.05$  and shown with \*.

Regarding medical drugs with the same coloring on the short-side surface as on the front surface of individual package cases (hereafter referred as “with coloring”) and those without the same coloring on the short-side surface as on front surface of individual package cases (hereafter referred as “without coloring”), the times required for finding medical drugs by the pharmacist group are shown in Fig. 2, and those by the student group are shown in Fig. 3; and the times required for finding medical drugs “with coloring” shown in sample sheets A and B by both groups are shown in Fig. 4. The times required by the pharmacist group (average ± standard deviation) were  $4.3 \pm 2.8$  seconds in the case of sample sheet A “with coloring,”  $10.5 \pm 6.1$  seconds in the case “without coloring,”  $7.6 \pm 4.4$  seconds in the case of sample sheet B “with coloring” and  $11.0 \pm 6.3$  seconds “without coloring.” The times required by the student group (average ± standard deviation) were  $4.5 \pm 2.4$  seconds in the case of sample sheet A “with coloring,”  $15.2 \pm 9.3$  seconds “without coloring,”  $7.2 \pm 3.3$  seconds in the case of sample sheet B “with color” and  $10.8 \pm 4.5$  seconds “without coloring.” In both sample sheets A and B, the times required were significantly shorter when it was “with coloring.” Furthermore, as the comparison between sample sheets A and B, in the case of sample sheet A, when it was “with coloring,” the times required were significantly shorter in both the pharmacist group and the student group.



**Fig. 4** Comparison of times required (in seconds) for finding “with coloring” shown in sample sheets A and B by the pharmacist group and the student group  
 From the required times (in seconds) (average  $\pm$  standard deviation) for finding “with coloring” by the pharmacist group (n = 21) and the student group (n = 13), sample sheets A and B were compared by each group, and the results were shown. They were analyzed by Student’s t-test with a significant difference of  $P < 0.05$  and shown with \*.

### 3.1.2 Gaze Analyzing Investigation

The heatmaps of the experiment using sample sheet A are shown in Fig. 5 and those of the experiment using sample sheet B are shown in Fig. 6. (Heatmaps of 17 subjects of the pharmacists were analyzable.) When searching for “with coloring,” the gaze on the heatmap was more stable than when searching for “without coloring” in both sample sheets A and B.

### 3.2 Hearing Investigation

The orders of the confirmation of the design of a product are from band color to product name to specification (large) by 11 subjects; from band color to specification (large) to product name by eight subjects; from product name to specification (large) by seven subjects; from band color to product name to specification (small) by five subjects and from product name to specification (small) by three subjects. Twenty-four subjects (70.6%) identified the medical drug from the band color on the lower part of individual package cases; 15 pharmacists (71.4%) and nine students (69.2%). Twenty-six subjects (76.5%) confirmed with the specification (large), which is strongly emphasized with coloring (Fig. 7); 17

pharmacists (81.0%) and nine students (69.2%). To the question asked only to pharmacists about whether they are dispensing medical drugs while imaging the front surface of individual package cases, eleven pharmacists (52.4%) answered that they are doing so while imagining it at least a little.



**Fig. 5** Heatmap generated from eye tracker on sample sheet A This is the figure of the heatmap showing gaze retention times of “with coloring” (middle) and “without coloring” (right) being superimposed on sample sheet A (left). The colors shown on the heatmap show longer gazing times in an ascending order from green to yellow to red.



**Fig. 6** Heatmap generated from eye tracker on sample sheet B This is the figure of the heatmap showing gaze retention times of “with coloring” (middle) and “without coloring” (right) being superimposed on sample sheet B (left). The colors shown on the heatmap show longer gazing times in ascending order from green to yellow to red.



**Fig. 7** Examples of medical drugs with the same coloring on the short-side surface as on the front surface of individual package cases.

#### 4. Discussion

When finding medical drugs with the same coloring on the short-side surface as on the front surface of individual package cases, the times required (in seconds) were significantly shorter than the cases without

the same coloring on the short-side surface as on the front surface and the gaze on the heatmap was more stable, which suggests that information such as coloring greatly affects identification on the short-side of individual package case. Even though it was informed to the subjects before the experiment that the design on the front surface and that on the short-side surface are not always the same, more than half of the subjects (70.6%) identified medical drugs by the colored part of the design (band color). At the hearing investigation after the experiment, to the questions asked to pharmacists whether they are imagining the front surface of individual package cases while dispensing medical drugs, even though there were differences in frequency in the imaging, more than half of them answered “yes.” Therefore, when the coloring and layout on the short-side surface are different from those on the front surface, pharmacists may be bewildered when dispensing medical drugs and it may lead to a mistake in picking them up. Therefore, in order to prevent mistakes in picking up medical drugs, the coloring on the short-side surface should be the same as that on the front surface of individual package cases.

This research was conducted targeting a student group and a pharmacist group, and some differences were observed between the two groups. The student group consisted of students in their sixth year of a pharmaceutical department, who acquired basic pharmaceutical knowledge and five-months of experience at pharmacies and hospitals as a training course. Thus, these students were supposed to have skills relatively comparable to newly qualified pharmacists. Comparing both groups, these experiments can suggest points of attention to produce a training course for pharmacy students and supervise fresh pharmacists. As a result, when finding medical drugs without the same coloring on the short-side surface of the sample sheet A where a different design is assumed by each medical drug, there was a difference of 4.7 seconds between the average times required by the pharmacist group and the student group; therefore, it is considered that the student group was more dependent upon coloring when finding medical drugs more than the pharmacist group was. However, in the hearing investigation on the order of confirmation of products after the experiment, the subjects who found medical drugs by color (color band) were nine students out of 13 (69.2%) and 15 pharmacists out of 21 (71.4%); there was no difference between the student group and the pharmacist group. It can be considered, because the pharmacist group did not depend on coloring only even when they confirmed medical drugs by coloring, they did not require as much time as the students did even when there was not the same coloring on short-side surface. From these facts, it was presumed that the presence or absence of coloring on the short-side surface of individual package cases is a very important factor for students and pharmacists without enough experience when dispensing medical drugs. Furthermore, as the comparison of sample sheets A and B, when finding medical drugs with the same coloring on the short-side surface as on the front face of individual package cases, in the case of sample A, the times required (in seconds) were significantly shorter for both the student group and the pharmacist group, so even though several pharmaceutical companies employ a company uniform design, it is also important to consider the design and coloring of each product unit.

Furthermore, from the hearing investigation after the experiment, it was revealed that 76.5% of the subjects confirmed medical drugs by the part of specification greatly emphasized by coloring, which means the part of design (coloring in the shape of belt at the under part of individual package case in this experiment) is highly paid attention to, so that if the specification is described there, it can prevent mistakes in specification. However, as the space of the short-side surface is smaller than that of the front



surface of individual package cases, the amount of information that can be described in this space also becomes smaller. Recently, due to the prevalence of branded generic drugs, long medical drug names often can be seen, and therefore, the blank space becomes narrower and the space for a design is limited. From this experiment, it was revealed that coloring is an important identification element. Therefore, it is necessary to discuss how to describe a design with colors in the limited space on the short-side surface of individual package cases.

This research is for the comparison of presence and absence of colors on the short-side surface of individual package cases; however, as other factors, there are color combinations, shape of designs, character fonts and pictograms. Even though it is for the purpose of the prevention of mistakes while picking up medical drugs, it is clear that there are many complicated factors such as requirements for keeping the consistency of the medical drugs, the clarity of expression of the specification that is important information, other miscellaneous standards and discrimination from other medical drugs<sup>6)</sup>. It is also required to discuss what sort of design can improve medical drug identification, not centering on colors only, but also the size and font of characters in the future.

Finally, in this research, the ranges of a subjects' eye moving was visually confirmed via heatmap; however, further research will also require comparing them by quantifying the ranges of eye movement from the retention time and arrival frequencies of gaze in each area. We will continue experimental research for developing package designs and co-producing packages with a manufacturing company of pharmaceutical packaging. We hope that highly distinguishable designs on improved package boxes will play a key role in preventing picking errors from pharmacists.

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## 医薬品個装ケース短側面情報の識別研究

山本 晃之、根岸 健一、福井 絢子、宮宗 耕平、青山 隆夫、上村 直樹

本研究は薬剤師の医薬品取り間違い事故防止の観点から、個装ケース短側面情報の識別について実験を通して明らかにすることを目的とした。被験者に個装ケース正面のデザインが記載されたシートを見せ、調剤台の引き出しをイメージして作成した個装ケース短側面のデザインがランダムに並べられたサンプルシートの中から、指定した医薬品を探し出すまでの所要秒数を比較した。所要秒数は、薬剤師群・学生群ともに全ての場合で、個装ケース正面と同等の色が短側面にもある医薬品の方が有意に短かった。また、短側面に同等の色がない医薬品を探す場合と比較して、ヒートマップ上の視線のばらつきが少なかった。これらの結果から、個装ケース短側面での識別には色などの情報が大きく影響を与えていることが示唆された。

**キーワード**： 医薬品個装ケース、短側面、デザイン、色