Matrix type product display: Its concept and effectiveness

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Cite as:
Moriguchi Takeshi, Kawamata Hisashi, Abe Shuzo (2020), Matrix type product display: Its concept and effectiveness. *Proceedings of the European Marketing Academy*, 11th, (84896)

Paper presented at the 11th Regional EMAC Regional Conference, Zagreb (online), September 16-19,2020

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Abstract:

The method of product display has been of great interest in academic and practical areas. Above all, the comparison between vertical and horizontal display has been the focus of existing research. For example, Deng et al. (2016) found the advantage of horizontal display from the perspective of consumers' perception and actual behavior. In this paper, using the concept of matrix type product display, we reveal the advantage of horizontal display isn't universal. Two Studies examine that consumers perceive greater ease of comparison and higher evaluation on the matrix type display regardless of whether it is a horizontal or vertical display.

Keywords: matrix format, product display, ease of comparison

1. Introduction

The question of how to align multiple products when presenting them to consumers has been of great interest in both academic and practical areas. Among many approaches to examine the methods of product display, the comparison between vertical and horizontal display has often been the focus of existing research. For example, utilizing field experiments, lab experiments and eye tracking tests, Deng, Kahn, Unnava, and Lee (2016) found that when presenting the same assortment in these two variations, displaying products horizontally evoked a perception of higher variety for consumers, leading them to actually choose a wider variety of products (as measured by number of unique options selected). They explain their results by pointing to the fact that the human binocular field of vision stretches out horizontally and that the dominant direction of eye movement is horizontal, which harmonizes with the horizontal display. Due to these characteristics of human vision, information processing fluency and perceived variety are higher when viewing something displayed horizontally.

However, do these findings mean that horizontal display advantages are remain the same under all situations? Regarding this issue, Ariga (2018) conducted a 2 x 2 between-subjects factorial design experiment in which he had Japanese participants read vertically or horizontally oriented texts and then proceeded to expose them to horizontal or vertical displays. As a result, participants who had read the horizontal text in advance selected more variety when viewing the horizontal display, whereas participants who had read the vertical text in advance selected more variety when exposed to the vertical display. Thus, Ariga (2018) shows that horizontal display is not universally superior to vertical display.

To follow up on Ariga (2018) and further clarify that the advantage of horizontal display over vertical display is situationally dependent, in this study we introduce the concept of matrix type product display. Numerous studies have shown that the way information is presented has a significant effect on information processing (Jarvenpaa, 1989; Kleinmuntz & Schkade, 1993; Schkade & Kleinmuntz, 1994). In Kleinmuntz and Schkade (1993), for example, the authors show that when the same information is presented in a matrix and a list, the former requires less effort in information processing (measured in terms of decision-making time) than the latter. The effectiveness of matrix type in information display has been confirmed in many existing studies. In this paper, we verify that the matrix type is also effective in product displays. Study 1 examines that consumers perceive greater ease of comparison and higher evaluation on the matrix type product display compared with the non-matrix type display. Study 2 reveals the mechanism that leads to the advantage of matrix type product display.

2. The concept of matrix type product display

In connection with above discussions, Okano, Amano, Araki, and Konishi (2006) focus on the determination of similarity between two patterns consisting of a white or black oval pattern and show that compared to the patterns in fig. 1a, it is easier to determine pattern similarity in the case of fig. 1b. In the case of fig. 1b, when checking whether the leftmost white oval is common to the two patterns, for example, there is no obstacle positioned between them, making the comparison easy. On the other hand, in the case of fig. 1a, when comparing the leftmost white oval between the two patterns, other ovals interfere, making it difficult to determine their similarity. Here, since each pattern is composed of twelve ovals, fig. 1b can be interpreted as being displayed in a 2 x 12 matrix format, but fig. 1a is not displayed in a matrix format. Thus, for matrix type display, when comparing specific components (e.g. the leftmost white oval) between different objects, other components do not interfere. In the case of non-matrix type display, however, when specific components are compared among different objects, other components intervene and become an obstacle. This explains the ease of comparison for matrix type display.

Fig. 1a. Horizontal placement

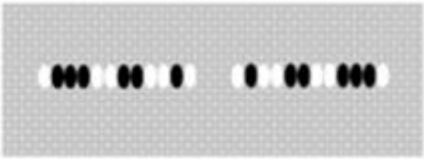
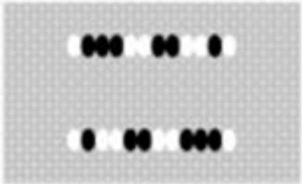


Fig. 1b. Vertical placement



Source: Okano et al. (2006), p.1992.

Based on the above consideration, let us now consider the concept of matrix types in product display, taking a notebook PC as an example. When a typical notebook PC is opened and displayed, the screen is located at the top and the keyboard at the bottom. At this time, by displaying the multiple products in a horizontal manner, consumers can easily compare screen to screen or keyboard to keyboard between products. On the other hand, when the products are displayed vertically, trying to compare screens (keyboards) between products becomes difficult as keyboards (screens) intervene and obstruct a direct comparison. In this case it can be said that the former horizontal display of notebook PCs corresponds to a matrix type, the latter vertical display to a non-matrix type.

Given this, we can define a matrix type and non-matrix type in product display, if the components of a product can be separated vertically or horizontally, like a display and a keyboard of a notebook PC. Thus, for such product display, it is no longer horizontal or vertical display that determines ease of comparison, but instead whether products are displayed in a matrix format or not. Furthermore, it is conceivable that such ease of comparison leads to a positive evaluation of the entire display. From the observations thus far, we propose the following hypotheses.

H1. Regarding the products where components are separated vertically or horizontally, regardless of whether products are displayed horizontally or vertically, ease of comparison is higher in the case of a matrix type display than a non-matrix type display.

H2. Regarding the products where components are separated vertically or horizontally, regardless of whether products are displayed horizontally or vertically, a matrix type display is evaluated higher than a non-matrix type display.

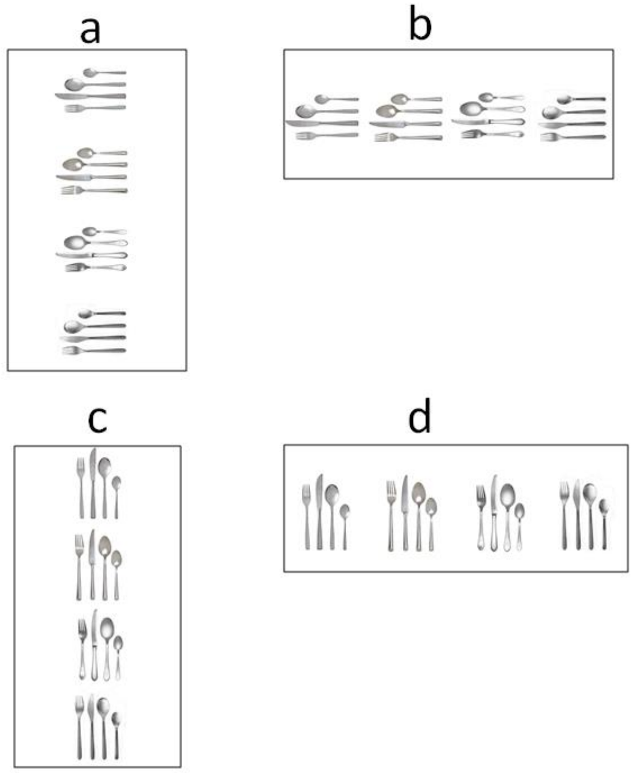
H3. The high evaluation of matrix type display is mediated by its ease of comparison.

3. Study 1

3.1 Stimuli

To examine the effectiveness of matrix type display, we used cutlery sets in Study 1. Each cutlery set was composed of four cutleries: a fork, a knife, and long and short spoons. Therefore, in Study 1, we can say that these four cutleries (fork, knife and spoons) are the components that make up each product (cutlery set). When arranging each cutlery set horizontally (fig. 2a and 2b), the horizontal display in fig. 2b becomes a matrix type display, which is assumed to make it easy for consumers to compare forks (knifes/spoons) with each other among different cutlery sets. On the other hand, the vertical display in fig. 2a becomes a non-matrix type display, making it difficult for consumers to compare forks (knifes/spoons) among cutlery sets due to other cutleries interfering. Conversely, if each cutlery set is arranged vertically (fig. 2c and 2d), the vertical display in fig. 2c becomes a matrix format, making it easy for consumers to compare forks (knifes/spoons) with each other among different cutlery sets. On the other hand, the horizontal display in fig. 2d becomes a non-matrix type display, making it difficult for consumers to compare forks (knifes/spoons) among cutlery sets due to other cutleries interfering.

Fig. 2. Four types of cutlery set display



3.2 Method

Participants (N = 362, 66.6% male, M_{age} = 45.6) were recruited using Yahoo! Cloud Sourcing online subject pool. Participants were randomly divided into four groups and each group was told to look at one out of four - 2 (product direction: vertical vs. horizontal) x 2 (display direction: vertical vs. horizontal) product displays. The four different displays of cutlery sets are shown in fig. 2a-2d., with 2b and 2c being matrix type displays and the others being non-matrix type displays, as mentioned previously. After viewing their respective product display, participants responded to questions about their ease of comparison (1. not at all easy - 7. very easy) and display evaluation (good / preferred / attractive; $\alpha = 0.892$).

3.3 Results

A two-way ANOVA with ease of comparison as the dependent variable showed that the interaction between the two factors was significant (F = 10.296, p =.001, η^2 = 0.027). Then, as a result of analyzing the simple main effect, when the product direction was horizontal, the value for ease of comparison was significantly higher for the horizontal display than the vertical display ($M_{horizontal}$ = 4.691 vs. $M_{vertical}$ = 4.256; t = 2.026, p = .043, d = 0.30). In contrast, when the product direction was vertical, the value for ease of comparison was significantly higher for the vertical display than the horizontal display ($M_{vertical}$ = 4.337 vs. $M_{horizontal}$ = 3.800; t = 2.513, p = .012, d = 0.50). Thus, H1 is supported.

Next, we performed a two-way ANOVA with display evaluation as the dependent variable and found that the two-factor interaction was significant (F = 7.876, p = .005, η^2 = 0.021). Then, as a result of analyzing the simple main effect, when the product direction was horizontal, the value for ease of comparison was significantly higher for the horizontal display than the vertical display ($M_{horizontal}$ = 4.199 vs. $M_{vertical}$ = 3.833; t = 1.984, p = .048, d = 0.30). On the other hand, when the product direction was vertical, the value for ease of comparison was significantly higher for the vertical display than the horizontal display ($M_{vertical}$ = 4.004 vs. $M_{horizontal}$ = 3.641; t = 1.986, p = .048, d = 0.39). Thus, H2 is supported.

A mediation analysis (Hayes 2017, Model 4, bootstrapped 5,000 times) revealed a significant indirect effect from the type of display (1: matrix type, 0: non-matrix type) to the display evaluation through the ease of comparison (B = 0.315, SE = 0.099, 95%CI [0.131, 0.511]). Thus, H3 is supported.

3.4 Discussion

In Study1, we used four types of product display. When the product direction was horizontal, the horizontal display corresponded to a matrix type display, the vertical display to a non-matrix type display. Reflecting this, both ease of comparison and display evaluation of the horizontal display were higher than for the vertical display. On the other hand, when the product direction was vertical, the vertical display corresponded to a matrix type display, the horizontal display to a non-matrix type display. Reflecting this, both ease of comparison and display evaluation were higher for the vertical display than for the horizontal display. As such, we were able to confirm that the superiority of horizontal display over vertical display is not universal. Instead, the key factor determining ease of comparison and display evaluation is whether it is a matrix type display or not.

4. Study 2

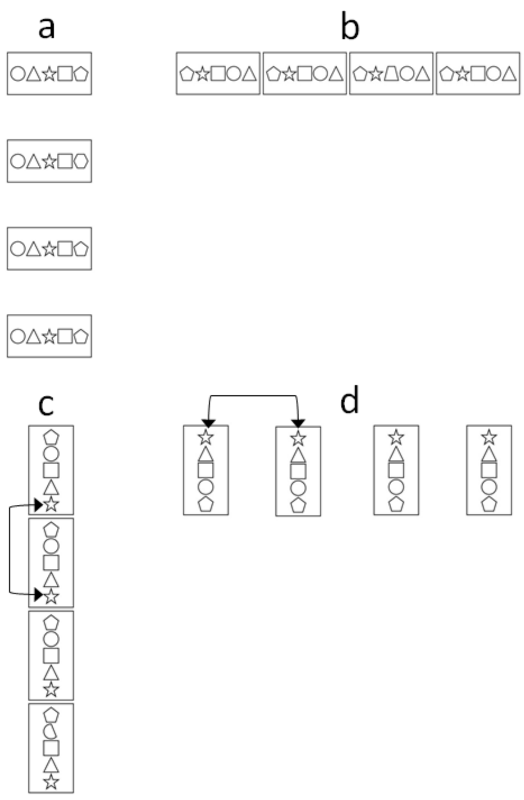
4.1 Motivation

Study 1 examined the superiority of matrix display over non-matrix display. The superiority was explained by the facts that for non-matrix type display (fig.2a, 2d), when comparing a specific product component (e.g. fork) among different products, other product components (e.g. knife, spoon) interfere, whereas for matrix type displays (fig.2b, 2c), no other product components interfere and obstruct the comparison. Alternatively, the results of study 1 could also be explained as follows: for example, if the product direction in Study 1 is vertical, the distance between the same product components (fork and fork, knife and knife, etc.) among multiple products is shorter for the matrix type display in fig. 2c than the non-matrix type display in fig. 2d. Therefore, we could also say that the reason for ease of comparison being higher for the matrix type display is not because no other product components interfere when comparing two of the same type of product components (fork and fork, etc.) among multiple products, but because the product components to be compared are positioned closer to each other. If we assume that this is correct, ease of comparison for matrix type display will disappear if for whatever reason the distance between product components to be compared in a matrix type display grows. Study 2 was implemented to rule out the possibility that a matrix type display´s ease of comparison could solely be attributed to a shorter distance between compared product components.

4.2 Stimuli

In Study 2, an experiment was conducted utilizing stimuli such as shown in fig. 3. Each stimulus is composed of four shape sets, with each shape set being composed of five types of shape elements (circle, square, etc.). The stimuli are either of identical condition (the arrangement of shape elements within the four shape sets is identical) or non-identical condition (the arrangement differs among shape sets, even if partly). For example, for the stimulus in fig. 3d, all shape elements included in the four shape sets are identical, but for the stimulus in fig. 3c, the second shape element from the top in the fourth shape set from the top is a semicircle and thus different from its counterparts in other shape sets. For Study 2, we prepared 24 different combinations of stimuli: 2 (shape set direction: vertical vs. horizontal) x 2 (display direction: vertical vs. horizontal) x 6 variations (3 with identical conditions, 3 with non-identical conditions). Here, among the stimuli for which the shape sets are arranged horizontally (figs. 3a, 3b), fig. 3a with the vertical display can be defined as a matrix type and fig. 3b with the horizontal display can be defined as a non-matrix type. Also, fig. 3d is matrix type display whereas fig. 3c is non-matrix type display.

Fig. 3. Four patterns of shape set display



Here, the stimuli are created so that the distance between specific shape elements among different shape sets (star and star, circle and circle, etc.) are identical. For example, the distance between the star-shaped elements indicated by the arrow in fig. 3c is equal to the distance indicated by the arrow in fig. 3d. The same applies to other shapes. Therefore, if ease of comparison of matrix type displays can be confirmed through Study 2, that would not be explained by distance between shape elements to be compared, but because other shape elements do not interfere when comparing specific shape elements among different shape sets.

4.3 Method

We recruited 38 undergraduate students (59.6% male, $M_{age} = 19.4$) from a major university in Tokyo, and showed them 24 different types of stimuli. The presentation order of stimuli was randomized for each participant. The participants were instructed to press a key after seeing each stimulus and determine whether the stimuli were identical or non-identical. Here, we measured the judgment accuracy for each stimulus as well as the response time needed to press the key.

4.4 Results

Since the accuracy for the identical/non-identical judgement was very high throughout the experiment (overall correct answer rate = 92%) and did not fluctuate with different stimuli, only the response time was used in our analysis to measure ease of comparison. As a result of a two-way ANOVA with response time as the dependent variable, the interaction of shape set direction and display direction was significant ($F = 62.369$, $p < .001$, $\eta^2 = 0.433$). Then, as a result of analyzing the simple main effect, when the shape set direction was horizontal, the vertical display produced a significantly shorter response time than the horizontal display ($M_{vetical} = 3.390$ sec. vs. $M_{horizontal} = 4.416$ sec.; $t = 7.281$, $p < .001$, $d = 0.618$). On the other hand, when the shape set direction was vertical, the horizontal display produced significantly shorter response time than the vertical display ($M_{horizontal} = 3.560$ sec. vs. $M_{vertical} = 4.440$ sec.; $t = 5.760$, $p < .001$, $d = 0.575$). Therefore, H1 once again is supported.

4.5 Discussion

In Study 2, using response time, we confirm that the ease of comparison for a matrix type display is higher than for a non-matrix type display. As described above, since we make sure the distance between shape elements is equal between for both the matrix type and non-matrix type display, this result can only be explained by the fact that no other shape elements interfere and interrupt the comparison of shape elements among matrix type displays.

5. Conclusion

In this study, we verified that the superiority of horizontal display over vertical display is not universal using the concept of matrix type product displays. As a result, when comparing a matrix type display with a non-matrix type display, regardless of whether it is a horizontal or vertical display, the ease of comparison for the matrix type display is always higher than that of the non-matrix type display, which, in turn, also affects the display evaluation. The advantage of horizontal display that Deng et al. (2016) declared was proven to be not universal by Ariga (2018), who prefixed the task of reading horizontal or vertical text. In contrast, in this research we do not utilize such a task and instead verified from a new perspective that the superiority of horizontal display is not universal. This finding is the academic contribution of this research.

In addition to the cutlery sets used in Study 1 and the notebook PCs used for the explanation, there are many other products whose elements are arranged vertically or horizontally. For example, a doll is composed of vertically arranged elements such as hair, face, body, and legs. In a photo calendar, the photo portion and calendar portion are arranged either vertically or horizontally. For products such as these, it is better to consider whether their product elements are aligned in a matrix or non-matrix format, rather than merely horizontally or vertically. This can be applied not only to display in offline and online stores, but also to print and online advertisements that present multiple products at the same time. This suggestion constitutes the practical contribution of this study.

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