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The authors investigate how horizontal versus vertical displays of alternatives affect assortment processing, perceived variety, and subsequent choice. Horizontal (vs. vertical) displays are easier to process due to a match between the human binocular vision field (which is horizontal in direction) and the dominant direction of eye movements required for processing horizontal displays. It is demonstrated that this processing fluency allows people to browse information more efficiently, which increases perceived assortment variety and ultimately leads to more variety being chosen, and if the number of options chosen is allowed to vary, it leads to more options chosen. It is shown that because people see more variety in a horizontal (vs. vertical) display, they process a horizontal assortment more extensively. When more variety is positive, they find the choice task easier and have a higher level of satisfaction and confidence about their choices. When more variety is not necessarily positive, for example, in a choice of a single most-preferred option, these effects disappear. Two field studies, an eye-tracking study, and two lab studies support these conclusions.

Keywords: horizontal versus vertical, retail assortment, perceived variety, eye movement, variety seeking

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A "Wide" Variety: Effects of Horizontal Versus Vertical Display on Assortment Processing, Perceived Variety, and Choice

Assortment variety is one of the critical variables that attract consumers to a store or to an online retail website (Iyengar and Lepper 2000; Mantrala et al. 2009). However, research has shown that despite consumers' preference for more variety when choosing among assortments, larger selections can yield lower purchase probabilities because of choice overload (Iyengar and Lepper 2000). One approach to minimizing the effect of too much variety is to manage the perceived rather than the actual variety (Broniarczyk, Hoyer, and McAlister 1998). Broniarczyk, Hoyer, and McAlister (1998) find that they can reduce SKUs without lowering perceived variety. Consistent with this finding, Townsend and Kahn (2014) show that even if the actual variety is held constant, higher perceptions of variety can attract consumers, making them more likely to choose; Kahn and Wansink (2004) find that higher levels of perceived variety can cause people to consume more.

Perceived variety can be increased by managing structural aspects of the assortment. For example, Morales et al. (2005) show that if the retailer designs the external structure of a product category to match consumers' internal categorization of that product category, consumers will perceive more variety and will be more satisfied with their choices. Mogilner, Rudnick, and Iyengar (2008) show that the mere presence of category labels within a product assortment can increase satisfaction with that assortment, especially for unfamiliar products. Townsend and Kahn (2014) show that for

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large assortments, design features (e.g., visual vs. verbal depiction) can be used to motivate consumers to spend more time processing and to process the options within the assortment more systematically, which leads to less perceived complexity and mitigates delay in choosing.

One of the critical ways consumers form assortment variety perceptions is by visually scanning the offering (Broniarczyk, Hoyer, and McAlister 1998; Hoch, Bradlow, and Wansink 1999); thus, it is very important that retailers grab the consumers at this visceral visual level. A fundamental visual cue that is widely used by merchants to attract attention, direct movement, and influence behavior is the use of horizontal versus vertical displays (see Figure 1) or the use of horizontal versus vertical blocking (see Figure 2). Blocking divides the display into horizontal or vertical blocks of similar products; the grouping can be based on product subcategory (Figure 2, Panel A), brand (Figure 2, Panel B), or product attributes (Figure 2, Panels C and D). It is almost always achieved through packaging design, especially by use of a distinct packaging color for each grouping. Retailers use color cues to visually direct customers' eye movements, thereby helping them navigate through a cluttered store shelf (DuPuis and Silva 2008).

We hypothesize that this visual factor (horizontal vs. vertical display or blocking) will influence how consumers process an assortment, which in turn will affect how much variety they perceive and subsequently how much variety they choose. Horizontal displays should be easier to process than vertical displays due to a match between binocular vision field (which is horizontal) and the dominant direction of eye movements for processing horizontal displays. This ease of processing should allow people to take in more information about the assortment in a given time, which should increase perceptions of variety. Higher levels of perceived variety should lead to more variety chosen (Kahn and Wansink 2004). Furthermore, because people see more variety in a horizontal versus a vertical display, when time is unconstrained, they should process the assortment more extensively. When the choice task allows for multiple options or multiple variants to be chosen, these characteristics of horizontal orientation should make the choice task easier (Townsend and Kahn 2014) and should lead to higher levels of satisfaction and confidence in their choices (Hoch, Bradlow, and Wansink 1999). In choice tasks wherein more variety is not necessarily positive, such as a task to choose only one favorite or choices for which simplicity and clear structure is preferred, the advantages of horizontal orientation disappear.

We begin with two field experiments (Studies 1–2) that provide support for our proposition that all else being held equal, horizontal (vs. vertical) displays will lead to more variety being chosen, that is, more unique items chosen. Then, in a lab experiment (Study 3), we show that when we tightly constrain the amount of time for processing an assortment, horizontal (vs. vertical) displays result in higher perceptual fluency. This initial processing fluency leads to perceptions of higher variety for the horizontal displays even when longer time is allowed for scanning, presumably because once perceptions are formed, people often use them to make subsequent judgments, do not seek disconfirming evidence, and even interpret later information around these initial impressions (Tversky and Kahneman 1974). These increases in perceived variety in turn result in more unique options chosen for the horizontal displays.

In a subsequent eye-tracking study (Study 4), we find evidence that in constrained-time conditions, participants

Figure 1

HORIZONTAL VERSUS VERTICAL RETAIL ASSORTMENT DISPLAYS

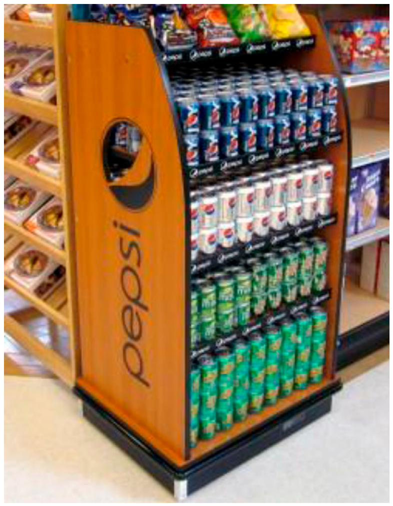
Figure 2
HORIZONTAL VERSUS VERTICAL BLOCKING

A: Sorted by Subcategory

C: Sorted by Product Attributes

B: Sorted by Brand

D: Sorted by Product Attributes



Notes: Panels A and B are examples of vertical blocking, and Panels C and D are examples of horizontal blocking.

are able to process more items per second of processing time in the horizontal versus vertical conditions. They also form larger consideration sets in the horizontal conditions. Later, when they see the same assortments again with unlimited time, they spend more time and process more items in the horizontal versus vertical displays, presumably because they started with higher initial perceptions of assortment variety and larger consideration sets for the horizontal displays. This appears to lead to larger choice sets for the horizontal displays.

Finally, in a quasi field study (Study 5), we test a boundary condition for our effects. In all of our previous experiments, participants were allowed to choose multiple options from the assortment. In this study, using familiar stimuli (branded chocolate candies), we add a condition in which participants may only chose one option. In this single-choice condition, perceived variety is less relevant because consumers are focusing on choosing their favorite option. We show that in the multiple-choice condition, consumers spend more time processing the assortment, find the choice task easier, and have greater satisfaction and confidence about their choices for horizontal versus vertical displays. These effects are not evident in the single-choice condition.

Our findings have important managerial implications because marketers seeking a customer share advantage have turned increasingly to managing the visual impact of point-of-purchase displays. Assortment variety is among the top three drivers of retail patronage, along with location and price (Broniarczyk and Hoyer 2010). Our findings suggest that when variety is positive (e.g., not contributing to choice overload), assortments designed for horizontal (vs. vertical) scanning can promote increased perceptions of assortment variety. Higher perceived assortment variety can increase share of wallet and consumption by increasing purchase quantities (Kahn and Wansink 2004).

We begin with the results of two field studies that document the central proposition that horizontal (vs. vertical) displays increase the variety of options chosen.

STUDY 1: SHOPPING MALL FIELD STUDY

We conducted a field study on a Saturday in February in a large U.S. city, in a national chain retail store that specializes in bath items, personal care items, and home fragrances (see Figure 3). The store used two types of fixture to showcase their pocket-sized hand sanitizers: a horizontal table display and a vertical display named "bubble tree" (see Figure 3). These two displays served as our manipulation. In this study, sample size was determined by recruiting as many participants as possible in one day in the store, with a minimum requirement of 20 participants per condition (Simmons, Nelson, and Simonsohn 2011). No compensation was offered to the participants.

For our study, we placed the two types of display fixture at two different, but equally visible and accessible, locations in the store. Each fixture contained 32 bins to display 32 different fragrances of the hand sanitizer. Each bin was filled with an equal number of items. Although the photographs in Figure 3 indicate that there were different promotional signs in the different displays, all signs were actually removed in the experimental tests.

When customers purchased this product, a store associate asked them to fill out a short survey about their shopping experience. In the survey, customers first checked the fragrances they chose (on a list of the 32 displayed fragrances) and reported the purchase quantity for each checked fragrance. Then, they indicated whether they shopped from the horizontal or from the vertical display (those who browsed or shopped both displays were not asked to do the survey). Finally, they provided an overall evaluation of the specific store display (1 = "bad," and 9 = "good"), as well as some personal information.

Sixty-seven customers (age 11–63; mean age = 36; 64 females) completed the survey. One-way (horizontal vs. vertical display) between-subjects analyses of variance (ANOVAs) showed that, compared with those who shopped the vertical display, customers who shopped the horizontal display purchased a greater quantity ($M_{horizontal}$ = 4.44, standard error of the mean [SEM] = .44 vs. $M_{vertical}$ = 2.75, SEM = .58; $F(1, 65) = 5.4$, $p = .02$, $\eta^2 = .08$) as well as a greater variety (number of distinct fragrances in the choices: $M_{horizontal}$ = 3.67, SEM = .29 vs. $M_{vertical}$ = 2.38, SEM = .38; $F(1, 65) = 7.4$, $p = .008$, $\eta^2 = .10$). There was no difference in the evaluation of the two store displays ($M_{horizontal}$ = 7.88, SEM = .14 vs. $M_{vertical}$ = 8.00, SEM = .19; $F(1, 65) = .2$, $p = .63$, $\eta^2 = .004$). We also found that the number of different fragrances purchased (i.e., amount of variety seeking) mediated the total quantity purchased. Our bootstrap analysis indicated that the indirect effect of display orientation (horizontal vs. vertical) on purchase quantity through the hypothesized mediator, variety seeking, was significant (b = .27, SE = .11; 95% confidence interval [CI] = [.08, .51]).

This field experiment provides support with actual purchase behavior that horizontal store displays, as opposed to vertical displays, promote a more diverse set of chosen options, resulting in increased purchase quantities. Next, we report the results of a second field study on a different population (children), wherein the dependent variable is choice rather than purchase.

STUDY 2: HALLOWEEN FIELD STUDY

The Halloween tradition of having children come to houses and choose candy from an assortment offered us the opportunity to develop a simple experiment to test how horizontal versus vertical displays affect the amount of variety chosen. In this study, sample size was determined by recording data for as many participants as possible during the "trick or treat" hours, with a minimum requirement of 20 participants per condition. No compensation was offered to the participants. Each child was offered an assortment of the following five candies: Hershey's, KitKat, M&M's, Snickers, and Twix. Each of the five candies was presented in bulk to the children in five transparent containers that could be arranged on a table either vertically or horizontally (see Figure 4). Because each container's height is equal to its width, the horizontal and vertical arrays of candy bins were of equal length. We presented the candy types in two random orders, which were counterbalanced across participants. When trick-or-treaters (approximate ages ranging from 3 to 14 years old) came to the door, they were assigned to either the vertical or the horizontal condition. In each case, the children were told that they could have any three pieces of candy. For example, they could have three different candies, three of the same, or any combination that added up to three. The candy containers were refilled so that every time a child approached the containers, they all appeared equally full. The study was videotaped, and we later replayed the video to record and analyze which candies each child picked.

Figure 3
STUDY 1 (SHOPPING MALL FIELD STUDY) MANIPULATION AND STIMULI

Horizontal Display | *Vertical Display*

Notes: All promotional signs were removed during the study. The number of bins (32) was held constant across the horizontal and vertical displays, and each bin was filled with an equal number of items.

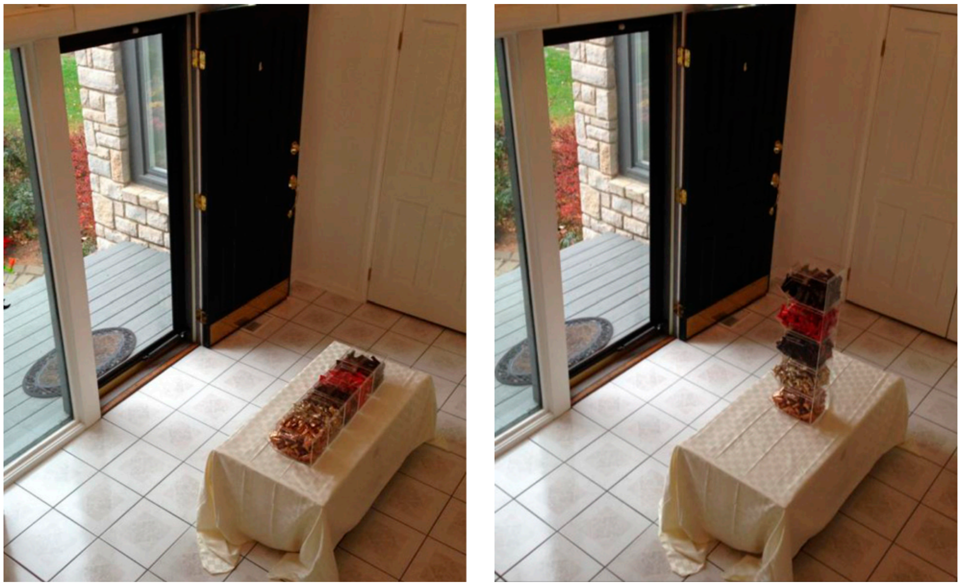
Forty-one children came to the house between 6:00 and 7:30 P.M. Of these children, we excluded seven from the data (three children picked fewer than three candies, three children picked more than three, and one child started picking candies before receiving the instructions), resulting in a final sample size of 34. The horizontal condition had 16 children and the vertical condition had 18. Due to the small sample size, several cells of the six possibilities (2 [orders: horizontal vs. vertical] × 3 [number of unique items chosen: one, two, or three]) had fewer than five participants per cell, so we focused only on whether children chose the maximum level of variety or did not. In the horizontal condition, 13 of the 16 children (81%) chose three unique candies. In the vertical condition, 8 of the 18 children (44%) chose three unique candies. Of the 21 children who chose three unique candies, 13 (62%) were in the horizontal condition, and 8 (38%) were in the vertical condition. Either way it is sorted, a significant difference exists between the vertical and horizontal conditions ($\chi^2(1, 34) = 4.9$, $p = .03$).

Both of these field studies provide evidence that horizontal displays result in the choice of more variety than vertical displays. We propose that horizontal displays lead to the choice of more variety because they can be processed more efficiently than vertical displays, resulting in greater perceived variety. The perceptions of higher variety appear to lead to larger consideration sets, which eventually lead to larger and more varied choice sets.

We now discuss how information displayed horizontally versus vertically is processed by the human eye to result in the differences detected in the first two field studies. To test

Figure 4
STUDY 2 (HALLOWEEN FIELD STUDY) MANIPULATION AND STIMULI

Horizontal Display	*Vertical Display*



our theorization, we then turn to the laboratory for our next three experiments (see Figure 5 for a road map of these three studies).

PROCESSING OF INFORMATION IN HORIZONTAL VERSUS VERTICAL DISPLAYS

When consumers are faced with a product display, they visually process the assortment in a matter of seconds (Dickson and Sawyer 1990; Hoyer 1984). We propose that this is easier if the assortment is scanned horizontally versus vertically, primarily because horizontal eye movements result in higher processing fluency of assortment information because our field of view is wider in the horizontal versus vertical direction. Humans view the world through binocular vision because they use two eyes in unison. As Figure 6, Panel A, shows, humans' forward-facing eyes give a maximum horizontal field of view of about 190° (120° make up the field of view seen by both eyes, shown in gray in Figure 6, Panel A, whereas the white area on each side of the figure indicates the left or right eye's unique field of vision) (*Academic Medicine* 1960). The design of televisions, computer monitors, and other screen-based products closely mimics the shape of binocular vision presumably because such a shape facilitates the processing of information displayed on the screen (Metallinos 1996; see Figure 6, Panel B).

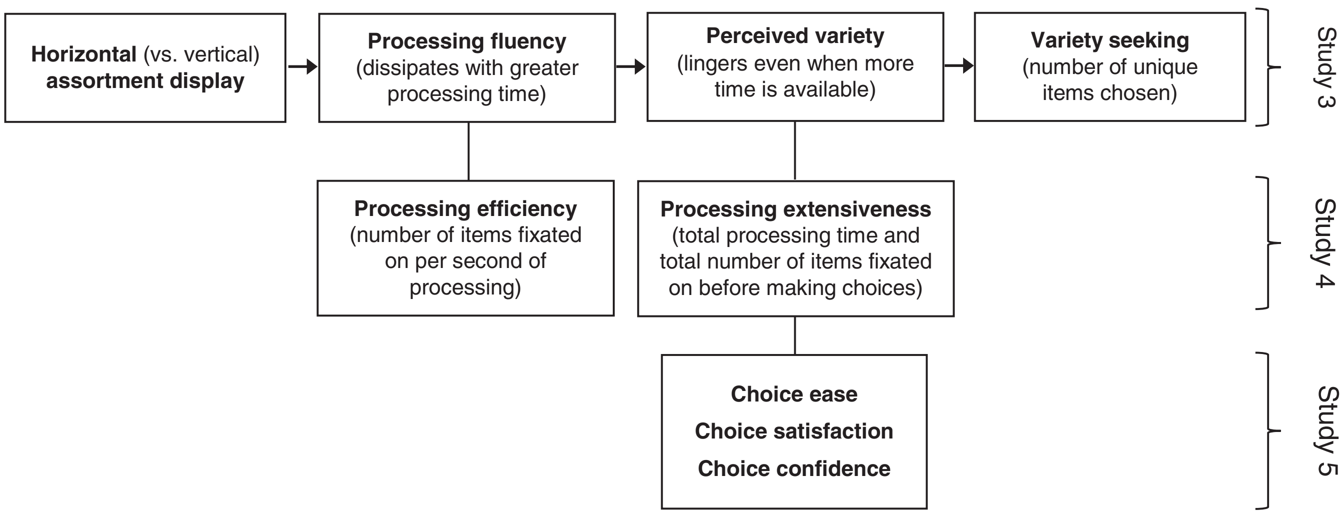
In addition, the perceptual span is the area from which an individual acquires information during a fixation (Rayner 1975). Reading studies have shown that the horizontal span of this area is almost twice as large as the vertical span (Ojanpää, Näsänen, and Kojo 2002). The perceptual span in visual processing mirrors that for reading (Rayner 1998). That the perceptual span is wider in the horizontal direction should facilitate horizontal (vs. vertical) eye movement, because there is more information available to direct the eyes horizontally (Shi, Wedel, and Pieters 2013). This suggests that horizontal scanning should be more fluent than vertical scanning.

Horizontal scanning is also easier because the muscles controlling horizontal eye movements are stronger than those controlling vertical movement (Cogan 1956). Finally, our head naturally rests forward (Griegel-Morris et. al 1992), so it takes more muscular effort to lift our eyes and scan vertically. This suggests that making vertical eye movements is more effortful and less convenient.

Based on the preceding points, we first conclude that horizontal scanning of information is more fluent than vertical scanning. The observation of the dominance of horizontal eye movements in various visual tasks (Gilchrist and Harvey 2006; Tatler and Vincent 2008; Van der Lans, Pieters and Wedel 2008) supports this conclusion. Also supporting our conclusion, various studies have found that performance in visual attention tasks is significantly better on the horizontal dimension than on the vertical dimension of the visual field (Collewijn, Erkelens, and Steinman 1988; Kröse and Julesz 1989; Nazir 1992; Yeshurun and Carrasco 1999).

Second, because horizontal scanning is more fluent than vertical scanning, we predict a higher level of processing efficiency when assortments are designed to promote horizontal versus vertical scanning. This is consistent with the finding that the subjective experience of perceptual fluency is based on the objective processing speed (Reber, Wurtz, and Zimmermann 2004). The common practice used to assess perceptual fluency and processing speed is to control the stimulus exposure time (Reber, Schwarz, and Winkielman 2004). We follow this practice to test the processing advantages of horizontal (vs. vertical) assortments in two lab experiments in which we constrain processing time (between subjects in Study 3 and

Figure 5
OVERVIEW OF STUDY 3, STUDY 4 (EYE-TRACKING STUDY), AND STUDY 5 (QUASI FIELD STUDY)



within subject in Study 4). In Study 3, we measure the subjective perceived fluency of processing and find support for horizontal advantages in the constrained-time condition. In Study 4, using eye-tracking technology, we show that horizontal processing is more efficient, resulting in more options fixated per second in constrained-time scans of an assortment.

The processing fluency and efficiency associated with horizontal assortments should allow consumers to take in a larger amount of information in a given, limited time. This should lead them to conclude that horizontal (vs. vertical) assortments have a higher level of variety. Although the processing advantages in terms of amount of information processed might dissipate when people have more time to process, we believe the initial perceptions of higher variety could still frame subsequent decisions. We hypothesize this for several reasons: (1) once people form perceptions, they often use them to make subsequent judgments; (2) they are not likely to seek disconfirming evidence although there are opportunities to do so; and (3) they may even distort later information in a way that is consistent with the initial perceptions (Kardes 1986; Russo et al. 2008; Tversky and Kahneman 1974). Thus, these initial perceptions of greater variety should linger, resulting in the formation of larger consideration sets in horizontal (vs. vertical) displays.

We would then hypothesize that in choice situations in which time is unconstrained, participants would spend a longer time processing the horizontal (vs. vertical) assortment and fixate on a higher number of items because these horizontal assortments are associated with perceptions of greater variety and larger consideration sets. However, because the horizontal processing advantages dissipate with time, we would not expect to see the higher processing efficiencies (i.e., more options fixated on per second) linger when more time is available—we hypothesize only that the initial perceptions of variety linger.

These conclusions that higher perceived variety would yield larger consideration sets support previous research that has shown higher perceived assortment variety can increase likelihood of purchase as well as consumption and choice quantities (Broniarczyk, Hoyer, and McAlister 1998; Kahn and Wansink 2004). Thus, we predict that because consumers perceive more variety from horizontal (vs. vertical) displays of product assortments, they are also likely to choose more items.

To summarize, a horizontal display, because of its ease of processing, leads people to process greater variety in a given time, and that perception of greater variety in turn leads them to choose more variety. We test this causal link in our next lab study, Study 3.

STUDY 3: LAB STUDY MEASURING PROCESSING FLUENCY AND PERCEIVED VARIETY

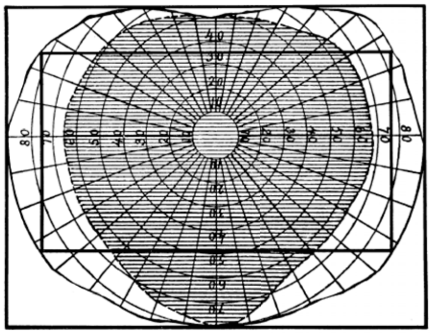
Method

Study 3 was computer mediated and used a 2 (assortment orientation: horizontal vs. vertical) × 2 (exposure time: 3 sec vs. 15 sec) between-subjects design. Our sample was 215 undergraduate students who participated in the study in exchange for course credit. Each participant was randomly assigned to one of the four conditions. Sample size was determined by recruiting as many participants as possible in one day in our lab, with a minimum requirement of 20 participants per condition.

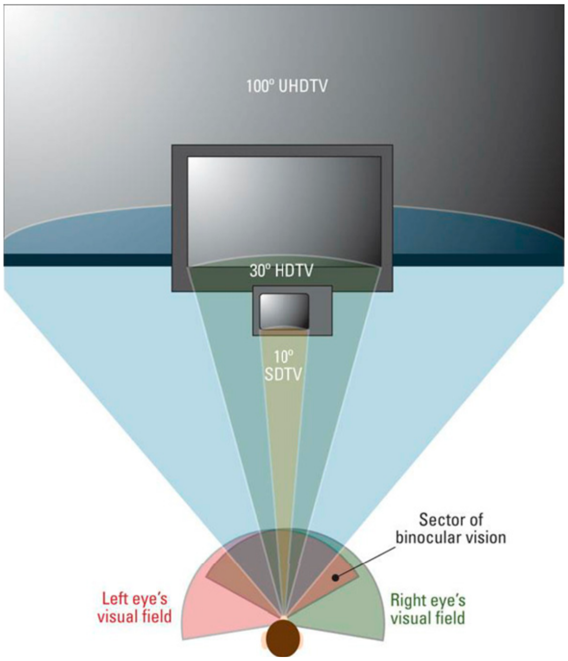
We told participants to view an assortment of chocolates as if they were in a candy store. We showed them either a horizontal or a vertical display of 10 chocolate truffles (see Figure 7) for either 3 or 15 sec. The exposure time manipulation was based on the assumption that if horizontal processing fluency advantages existed, we would need a very tight time frame to observe them (Reber, Schwarz, and Winkielman 2004; Reber, Wurtz, and Zimmermann 2004). Previous research that has shown consumers often spend only a brief time before making purchases decisions (Dickson and Sawyer 1990; Hoyer 1984) lends support for the ecological validity of this time manipulation. Although these initial processing advantages likely dissipate over time, we

Figure 6
BINOCULAR VISION FIELD

A: Binocular Vision Field Fitted with Internal and External Rectangles



B: Binocular Vision Field Influences Television Designs

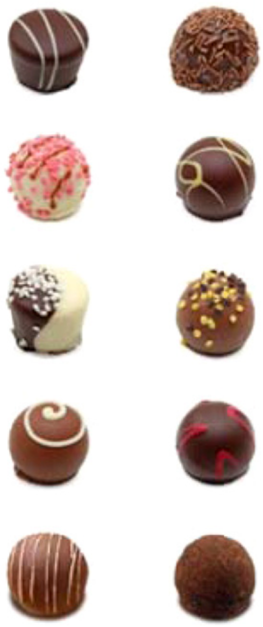


Notes: Current HDTV increases the field of view from 10° to 30°. As binocular vision subtends over 120°, the next generation of television aims to increase the field of view to around 100° (Austerberry 2011).

Figure 7
STUDY 3 MANIPULATION AND STIMULI

A. Horizontal Display

B. Vertical Display



are interested in whether the perceptions of higher variety linger, leading to differences in subsequent choice decisions.

Regardless of orientation, both displays fit within the computer screen, so participants did not have to scroll left–right or up–down to view all the items. We presented the 10 chocolates in the display in two random orders, which were counterbalanced across participants.

After viewing the chocolate assortment, participants responded to a series of questions. First, perceived assortment variety was measured by a nine-point scale: "How much variety do you think there is in this assortment?" (1 = "very little variety," and 9 = "very much variety"). This measure is consistent with previous research (Broniarczyk, Hoyer, and McAlister 1998; Hoch, Bradlow, and Wansink 1999; Kahn and Wansink 2004). Second, number of unique options chosen was measured as follows: "Consider choosing seven chocolates from this assortment. You can choose either seven of the same flavor, or up to seven different flavors. How many different flavors would you like to choose?" (1 = "1 flavor in 7 chocolates," and 7 = "7 flavors in 7 chocolates"). Third, perceived processing fluency was measured using two items rated on nine-point scales: "How easy was it to evaluate the information shown in this assortment?" (1 = "not at all easy," and 9 = "very easy") and "How comfortable did you feel when you evaluated the information shown in this assortment?" (1 = "not at all comfortable," and 9 = "very comfortable"). These items were adapted from Lee and Aaker (2004) and combined to form a "processing fluency" index (α = .80).

Results and Discussion

We expected to observe a horizontal processing fluency advantage only in the 3-sec condition, in which participants had to process the assortment under time constraint. In the 15-sec condition, in which participants had more than enough time to survey the assortment options, we expected no difference between horizontal and vertical conditions in processing fluency.

We hypothesize that the initial processing fluency advantages will increase perceptions of variety in the horizontal versus vertical assortments. Because people generally do not seek disconfirming evidence once perceptions have been formed, we believe that these increased perceptions of variety may linger in the 15-sec condition even after processing fluency advantages dissipate. It is an empirical question whether we see the perceived variety effect disappears as the processing fluency advantages fade away (i.e., an interaction effect) or we see a main effect of perceived variety across both time conditions, suggesting that the initial perceptions of variety are lingering. If the perceptions of variety linger even slightly, we should observe that participants choose a larger number of unique items in horizontal versus vertical displays.

A 2 × 2 ANOVA conducted on the processing fluency index revealed significant main effects of assortment orientation and exposure time: participants found processing the horizontal assortment to be more fluent than processing the vertical assortment ($M_{horizontal} = 5.86$, SEM = .17 vs. $M_{vertical} = 5.33$, SEM = .17; $F(1, 211) = 4.8$, $p = .03$, $\eta^2 = .02$), and found the processing to be more fluent when there was more time ($M_{3\ sec} = 5.32$, SEM = .18 vs. $M_{15\ sec} = 5.88$, SEM = .17; $F(1, 211) = 5.3$, $p = .02$, $\eta^2 = .02$). A significant two-way interaction ($F(1, 211) = 4.0$, $p < .05$, $\eta^2 = .02$) was also found. The planned comparisons showed that the difference between horizontal and vertical assortments in processing fluency was significant in the 3-sec condition ($M_{horizontal} = 5.83$, SEM = .25 vs. $M_{vertical} = 4.80$, SEM = .25; $t(211) = 2.9$, $p = .004$, $\eta^2 = .04$) but not in the 15-sec condition ($M_{horizontal} = 5.90$, SEM = .24 vs. $M_{vertical} = 5.85$, SEM = .23; $t(211) = .1$, $p = .89$, $\eta^2 = .0001$). Put differently, participants found processing the horizontal assortment to be equally fluent in the 3-sec and the 15-sec conditions ($t(211) = .2$, $p = .84$, $\eta^2 = .0002$) but found processing the vertical assortment to be less fluent when time was limited ($t(211) = 3.1$, $p = .003$, $\eta^2 = .04$).

The same ANOVA conducted on the perceived variety scale showed a significant main effect of orientation ($F(1, 211) = 6.0$, $p = .02$, $\eta^2 = .03$) but a nonsignificant orientation × time interaction ($F(1, 211) = 2.7$, $p < .10$, $\eta^2 = .01$). Overall, participants reported that there was more variety in the horizontal (M = 7.14, SEM = .15) than in the vertical (M = 6.61, SEM = .15) assortment. Thus, initial perceptions of variety appear to linger even when more time is available. These lingering perceptions of assortment variety should then affect subsequent choice.

When we analyzed the number of unique options chosen, we found only a significant main effect of assortment orientation, such that participants indicated a higher number of unique options for the horizontal than for the vertical assortment ($M_{horizontal} = 3.98$, SEM = .13 vs. $M_{vertical} = 3.60$, SEM = .13; $F(1, 211) = 4.1$, $p = .04$, $\eta^2 = .02$).

Our theory suggests that processing fluency is mediating the perceived variety effect, which in turn mediates the choice of unique options. We ran the mediation analyses following the recommendations by Zhao, Lynch, and Chen (2010). We used the SAS macro provided by Preacher and Hayes (2004), and our bootstrap analyses supported our proposed processes. First, the indirect effect of assortment orientation (horizontal vs. vertical) on perceived variety through the hypothesized mediator, processing fluency, was significant (b = .03, SE = .02; 95% CI = [.001, .07]). Second, the indirect effect of assortment orientation (horizontal vs. vertical) on number of unique options through the hypothesized mediator, perceived variety, was also significant (b = .04, SE = .02; 95% CI = .005 to .08).

EXTENSION OF SHOPPING MALL FIELD STUDY

Study 3 suggests that participants chose more variety in the horizontal display because they perceived the horizontal display to have more variety due to horizontal processing advantages. These results shed light on why in our field studies people chose more variety from horizontal versus vertical assortments. Although it would be difficult to measure processing fluency advantages in a shopping mall because that would require a tightly constrained time frame for consumers to view the assortment, which would be unrealistic, we could measure whether or not there were lingering perceptions of increased variety for horizontal versus vertical displays.

For an extension of Study 3, we returned to the mall environment where we conducted the first field study. We surveyed 46 customers (45 females; age not collected), who shopped from either the horizontal or the vertical display, with the following item: "Please estimate how many different fragrances of Pocket-Size Hand Sanitizers are shown in that store display: _____ (please write down a number between 10 and 50)." Consistent with the lab study, even after initial perceptual fluency advantages had presumably dissipated, consumers perceived more variety in the horizontal (M = 32.14, SEM = 1.59) than in the vertical (M = 22.46, SEM = 1.53) display ($F(1, 44) = 19.2$, $p < .0001$, $\eta^2 = .30$).

Study 3 demonstrates that horizontal (vs. vertical) assortments increase processing fluency. That study and the follow-up mall study show that even after the processing fluency advantages of horizontal displays dissipate with greater processing time, perceived assortment variety and subsequently the number of unique options chosen remain higher for horizontal (vs. vertical) displays. In Study 4, we use eye-tracking apparatus to provide further evidence that horizontal (vs. vertical) assortments increase processing efficiency when time is constrained. Moreover, when time is unconstrained, the higher perceived variety of horizontal displays should result in larger consideration sets, as well as a more extensive processing of displayed options.

STUDY 4: EYE-MOVEMENT EVIDENCE FOR PROCESSING EFFICIENCY AND PROCESSING EXTENSIVENESS

Study 4 uses eye-tracking methodology to find attention measures to support our hypothesis that horizontal (vs. vertical) processing is more efficient. These attention measures (e.g., fixations) allow us to develop an index to assess "processing efficiency." Specifically, we define processing efficiency as the number of options fixated on divided by total fixation time. It is a ratio index and provides a behavioral measure to support the perceived processing fluency scales used in Study 3. We can also use this methodology to confirm that horizontal and vertical product assortments indeed lead to primarily horizontal and vertical eye movements, respectively. Finally, this study differs from the previous studies because we manipulate horizontal versus vertical assortment through physical layout of the assortment as well as a graphic cue that induces horizontal or vertical eye movements. This graphic cue is consistent with a website design technique called "highlighting" (i.e., visually accentuating information through lines, colors, and shading; other techniques include sorting, grouping, trimming, etc.; see Shi, Wedel, and Pieters 2013). The stimulus design is also consistent with commonly seen retail assortment sets (see Figure 8; see also Figures 1 and 2)

Method

Twenty students participated in the study for payment. Sample size was determined according to previous research and the difficulty in time and effort in collecting this type of data. A lab assistant ran all participants, one at a time. She seated each participant in front of a computer equipped with a SensoMotoric Instruments RED-m eye-tracking device, calibrated the participant so the eye movements could be tracked by the software, and continued to monitor the participant throughout the study. Each session lasted about 30 minutes, and each participant was paid $10.

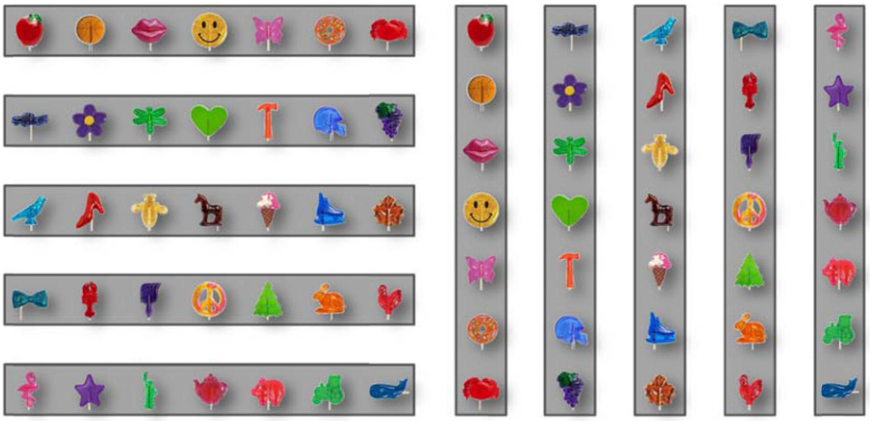
The study consisted of two parts: a constrained-time condition and an unconstrained-time condition executed within subject. If horizontal displays are easier to process, then in a constrained-time condition, people should process more alternatives per second of processing time. That is, they should be more efficient as measured by the number of alternatives fixated on per second in the horizontal versus vertical conditions. If the initial processing efficiencies yield lingering perceptions of variety, then in the unconstrained-time conditions, participants should spend more time and process more alternatives before making their decision. We can observe "processing extensiveness" by measuring total processing time and total number of alternatives fixated on prior to making the final choice.

Participants were told to quickly browse an assortment of lollipops available at www.melvillecandycompany.com. To make the task more believable, we showed them a screen shot of the actual website. Participants were also told they would only be able to see the assortment for a restricted amount of time (10 sec). Participants then viewed on the next screen an assortment of 35 different lollipops, horizontally or vertically oriented (see Figure 8, Panel A). Their eye movements during the 10-sec period were recorded. We then removed the assortment from their vision and displayed the following response item: "Imagine you are in a candy store and see this assortment of 35 lollipops. If you want to buy some for your own consumption, how many different types of lollipops would you like to purchase? Please provide a number between 1 and 35."

Participants then proceeded to the second part of the study. From the instruction, they learned that they would be shown the same lollipop assortment again, and their task this time was to choose which options they would want to purchase. They could pick as many options as they wished, and they could look at the assortment as long as they needed

Figure 8
STUDY 4 (EYE-TRACKING STUDY) MANIPULATION AND STIMULI

A: Horizontal Versus Vertical Assortment Stimuli



B: Retail Assortment Displays Similar to the (Vertical) Assortment Stimuli

to. Their eye movements were again recorded. Afterward, they proceeded to the next screen and wrote down simple descriptive terms (“apple,” “butterfly,” “smiley face,” etc.) to indicate their lollipop choices.

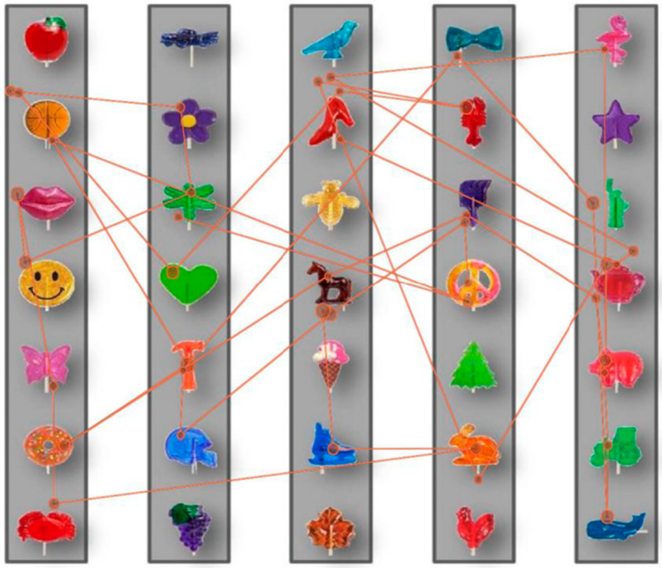
Results and Discussion

The lollipop assortment was delineated into specific areas of interest (AOIs), with each AOI associated with a single lollipop. We analyzed the data such that all points within an AOI were considered a fixation on that specific lollipop.

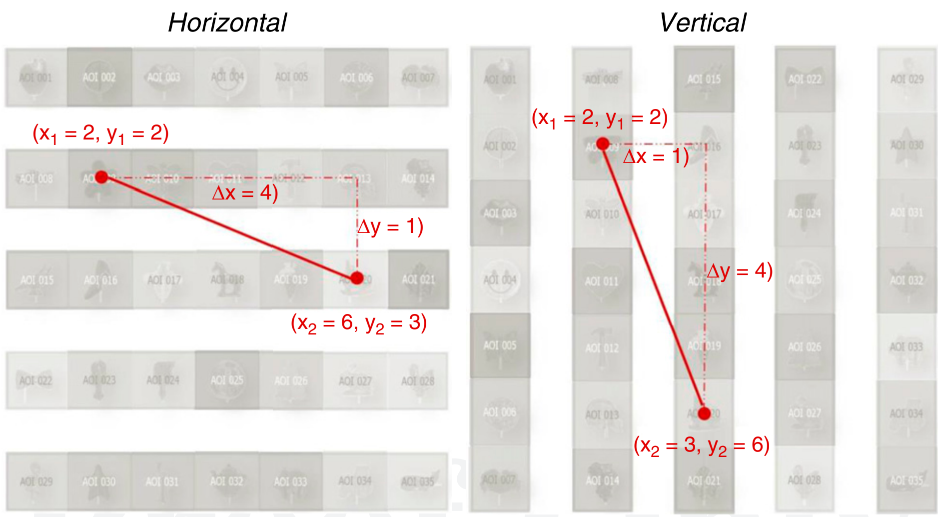
Manipulation checks. To provide some evidence that participants engaged in horizontal (vs. vertical) eye scanning when processing a horizontal (vs. vertical) assortment, we first need to categorize the seemingly random eye movements (see Figure 9, Panel A) as either horizontal or vertical. For any movement between options, whereby the participant’s eye fixations moved from one lollipop AOI to another lollipop AOI, we assigned x_1 and y_1 to the beginning point of the movement and x_2 and y_2 to the end point of the movement, with x and y representing the column and row number, respectively, in the assortment (see Figure 9, Panel B). We then calculated Δx (i.e., $x_2 - x_1$) and Δy ($y_2 - y_1$), as well as the difference between the magnitudes of Δx and Δy (i.e., $|\Delta x| - |\Delta y|$). If an eye scan traveled a greater distance in the horizontal than in the vertical direction (i.e., $|\Delta x| > |\Delta y|$),

Figure 9
DEFINING HORIZONTAL VERSUS VERTICAL EYE MOVEMENTS

A: Eye Scans of a Participant



B: Eye Scans Categorized as Horizontal or Vertical Eye Movement



then we define it as a horizontal eye movement (left side of Figure 9, Panel B). If it traveled a smaller distance in the horizontal than in the vertical direction (i.e., $|\Delta x| < |\Delta y|$), we categorize it as a vertical eye movement (right side of Figure 9, Panel B). If $|\Delta x| = |\Delta y|$, we consider the scan a neutral eye movement.

Table 1 summarizes the frequencies of horizontal versus vertical eye movements and reports SEMs and effect sizes (η^2). In the first part of the study (i.e., browsing stage/constrained-time condition), we found significantly more horizontal movements in the horizontal condition (M = 16.38) than in the vertical condition (M = 5.27; $F(1,17) = 39.8$, $p < .0001$), significantly more vertical movements in the vertical condition (M = 11.36) than in the horizontal condition (M = 3.00; $F(1,17) = 35.6$, $p < .0001$), and no difference in the number of neutral movements between conditions ($p = .15$). These results show that horizontal (vertical) eye movements clearly dominated the processing of horizontal (vertical) assortment.

In the second part of the study (i.e., choosing stage/unconstrained-time condition), we observed similar patterns. We found significantly more horizontal movements in the horizontal condition (M = 14.00) than in the vertical condition (M = 4.36; $F(1, 18) = 19.2$, $p = .0004$), significantly more vertical movements in the vertical condition (M = 9.27) than in the horizontal condition (M = 4.67; $F(1, 18) = 14.8$, $p = .001$), and again no difference between conditions in the number of neutral movements ($p = .57$). These results show that our manipulation of assortment orientation successfully resulted in systematically horizontal and vertical eye movements. These results are also consistent with previous findings that the layout of visual displays affects the direction of eye movements in both scene viewing (Tatler and Vincent 2008) and brand search task (Van der Lans, Pieters, and Wedel 2008).

Note that a possible account for our hypothesis (i.e., horizontal scanning is more fluent and efficient than vertical scanning) is that Western, English-speaking participants are more familiar with horizontal scanning because they are trained to read from left to right (and not top to bottom, etc.). If this were the underlying process, we should see more left-to-right scanning than right-to-left and more horizontal scanning overall regardless of assortment orientation. We conducted additional analysis on the leftward/rightward or upward/downward direction of eye movements and found that there was no particular direction that dominated horizontal or vertical eye movements, thus ruling out a "reading" alternative hypothesis (for details, see Web Appendix A).

Processing efficiency in constrained-time condition. Table 2 summarizes our main findings from hypothesis testing and reports all SEMs and effect sizes (η^2). In the constrained-time condition, we predicted that the number of options fixated on per second, which defines "processing efficiency," should be greater in the horizontal (vs. vertical) display condition. We found support for this prediction. Participants in the horizontal condition fixated on a greater number of options per second of processing time (M = 3.26) than those in the vertical condition (M = 2.77; $F(1,17) = 6.9$, $p = .02$). This processing efficiency advantage appears to be driven by both a directionally greater number of options fixated on in the horizontal (M = 22.50, or 64% of total options) than in the vertical condition (M = 20.91, or 60%; $F(1,17) = 1.0$, $p = .34$) and a marginally shorter total fixation time (i.e., the total time spent on fixated options; in seconds) in the horizontal (M = 6.89) than in the vertical condition (M = 7.59; $F(1,17) = 2.9$, $p = .10$). That is, participants in the horizontal condition needed less time to fixate on any given option, on average, than those in the vertical condition.

Table 1
STUDY 4 (EYE-TRACKING STUDY) MANIPULATION CHECKS

	Browsing/Constrained Time (n = 19)			*Choosing/Unconstrained Time (n = 20)*		
	Horizontal Display		*Vertical Display*	*Horizontal Display*		*Vertical Display*
Number of Eye Movements	21.25 (1.20)		19.36 (1.02)	20.67 (1.59)		16.18 (1.44)
F-test		F(1, 17) = 1.4			F(1, 18) = 4.4	
p-value		.25			.05	
η^2		.08			.20	
Number of Horizontal Movements	16.38 (1.34)		5.27 (1.14)	14.00 (1.63)		4.36 (1.47)
F-test		F(1, 17) = 39.8			F(1, 18) = 19.2	
p-value		< .0001			.0004	
η^2		.70			.52	
Number of Vertical Movements	3.00 (1.07)		11.36 (.91)	4.67 (.89)		9.27 (.80)
F-test		F(1, 17) = 35.6			F(1, 18) = 14.8	
p-value		< .0001			.001	
η^2		.68			.45	
Number of Neutral Movements	1.88 (.43)		2.73 (.37)	2.00 (.70)		2.55 (.63)
F-test		F(1, 17) = 2.3			F(1, 18) = .3	
p-value		.15			.57	
η^2		.12			.02	

Notes: SEMs are reported in parentheses. We excluded one participant's data collected in the browsing stage/constrained-time viewing condition because a programming error led to a significantly shorter stimulus exposure time for this participant.

Table 2
STUDY 4 (EYE-TRACKING STUDY) RESULTS

	Browsing/Constrained Time (n = 19)		*Choosing/Unconstrained Time (n = 20)*	
	Horizontal Display	*Vertical Display*	*Horizontal Display*	*Vertical Display*
Processing Efficiency (Number of Options Fixated on per Second)	3.26 (.14)	2.77 (.12)	2.02 (.18)	2.29 (.16)
F-test	F(1, 17) = 6.9		F(1, 18) = 1.3	
p-value	.02		.27	
η^2	.29		.07	
Processing Extensiveness (Total Number of Options Fixated On)	22.50 (1.23)	20.91(1.05)	22.33 (1.58)	17.73 (1.43)
F-test	F(1, 17) = 1.0		F(1, 18) = 4.7	
p-value	.34		.04	
η^2	.05		.21	
Processing Extensiveness (Total Fixation Time; sec)	6.89 (.31)	7.59 (.27)	12.20 (1.35)	7.85 (1.22)
F-test	F(1, 17) = 2.9		F(1, 18) = 5.8	
p-value	.10		.03	
η^2	.15		.24	
Number of Unique Options in the Consideration Set	7.11 (.75)	3.18 (.68)		
F-test	F(1, 18) = 15.2			
p-value	.001			
η^2	.46			
Number of Unique Options in the Choice Set			6.33 (.58)	3.91 (.53)
F-test			F(1, 18) = 9.5	
p-value			.006	
η^2			.35	

Notes: SEMs are reported in parentheses.

After browsing the assortment for 10 sec, participants created significantly larger consideration sets in the horizontal (M = 7.11 unique options in the consideration set) than in the vertical condition (M = 3.18; F(1, 18) = 15.2, *p* = .001).

Processing extensiveness in unconstrained-time condition. In the unconstrained-time condition, we predicted that larger consideration sets in the horizontal (vs. vertical) display condition should lead to more extensive processing. We found support for the expected effects on processing extensiveness. First, the number of options fixated on was greater in the horizontal condition (M = 22.33, or 64% of all options) than in the vertical condition (M = 17.73, or 51%; F(1, 18) = 4.7, *p* = .04). Second, the total fixation time (in seconds) was longer in the horizontal condition (M = 12.20) than in the vertical condition (M = 7.85; F(1, 18) = 5.8, *p* = .03). As expected, there was no difference between conditions on the efficiency of processing, that is, on the number of options fixated on per second (*p* = .27), suggesting that the processing efficiency advantage afforded by the horizontal display dissipates when time is not constrained.

Participants engaged in more extensive processing of assortment options and formed larger choice sets in the horizontal (M = 6.33 unique options in the choice set) versus the vertical condition (M = 3.91; F(1, 18) = 9.5, *p* = .006). This replicates the results we saw in Study 1, in which consumers were allowed to purchase as many items as they wanted (whereas in Studies 2 and 3, participants were constrained to a maximum number of options they could choose).

Our mediation analysis showed that, first, consideration set size mediated the effect of horizontal versus vertical display on processing extensiveness (b = 1.24, SE = .37, 95% CI = [.48, 2.00] for number of options fixated; b = 1.15, SE = .40, 95% CI = [.37, 1.93] for total fixation time). Second, processing extensiveness mediated the effect of display on choice set size (b = .63, SE = .31, 95% CI = [.03, 1.24] for number of options fixated; b = .72, SE = .33, 95% CI = [.07, 1.37] for total fixation time). These results suggest that horizontal (vs. vertical) displays, which are easier to process when time is constrained, can produce larger consideration sets that in turn lead to more extensive processing and larger choice sets when time is unconstrained.

To summarize, this eye-tracking study shows that, first, the horizontal and vertical assortment displays (created using both physical layouts and graphic cues) indeed led to dominantly horizontal and vertical eye movements, respectively. Second, scanning the horizontal (vs. vertical) assortment was more efficient, characterized by more options fixated on per second of processing time in constrained-time viewing. This processing efficiency presumably resulted in higher perceived assortment variety that produced larger consideration sets in the horizontal (vs. vertical) condition. However, in unconstrained-time viewing, the horizontal processing efficiency evaporated, but because lingering perceptions of higher variety and larger consideration sets had been formed in the horizontal condition from the initial viewing, participants spent more time and fixated on more options while choosing from the horizontal (vs. vertical) assortment. This resulted in larger choice sets in the horizontal (vs. vertical) condition.

STUDY 5: QUASI FIELD STUDY TESTING BOUNDARY CONDITION

In the last study, we identify a boundary condition for our results. In all of our previous studies, we maintained that the reason more variety and more options were chosen (if the number of options chosen was allowed to vary) in the horizontal conditions than in the vertical conditions is that the processing fluency associated initially with horizontal conditions yields higher perceptions of variety. Those perceptions of variety result in larger consideration sets that eventually lead to larger choice sets (when quantity purchased is not limited) or to more unique items chosen (when choice set sizes are limited). However, in each of these experiments, participants considered multiple-option choice sets. If the choice goal were to choose only one option, the focus should be on finding one's favorite rather than identifying acceptable variety. In that case, perceptions of variety should not be relevant and we should not see a difference between horizontal and vertical displays, especially in situations in which preferences are known.

In Study 5, we ask participants to make choices of well-known Halloween candies in a laboratory. Pretests (N = 36) show that participants have clear preferences among the brands. The mean preference scores (0 = "I don't like it at all," and 100 = "I like it extremely") for Hershey's, KitKat, M&M's, Snickers, and Twix were 58, 66, 65, 31, and 34 (SEMs = 4.61, 4.21, 4.85, 4.60, 5.73), respectively ($F(4, 140) = 12.8$, $p < .0001$, $\eta^2 = .23$). Given that Study 5 is a quasi field study, we asked participants to make real purchases, but we did so in a lab so that we could get additional measures, such as ease of choice task, satisfaction, and confidence.

Method

Study 5 was a 2 (choice task: single vs. multiple options) × 2 (choice display: horizontal vs. vertical orientation) between-subjects design. Our sample consisted of 271 undergraduate students who participated in the study in exchange for course credit. Sample size was determined by recruiting as many participants as possible in one day in our lab, with a minimum requirement of 20 participants per condition. Participants were told as a cover story that the study was a test of how store lighting affects people's shopping patterns. To make the task more realistic, the lab was being designed as a ministore, and they would be given $2 to spend in the store. We set up four ministores, each corresponding to an experimental condition. In each store, each of the five candies was presented in bulk to the participants in five transparent containers that could be arranged on a table either vertically or horizontally (similar to the Halloween field study setup). We presented the candies in two random orders, which were counterbalanced across participants. Each candy was priced at 25 cents per piece, and participants were told they could purchase as many pieces as they had money for but had to purchase at least one piece. They could keep any unused money at the end of the study.

In the single-option condition, participants were told to choose their favorite type of candy and to decide how much they wanted of that type. In the multiple-option condition, participants were told to choose their favorite types of candy and to decide how many pieces of each type they wanted to purchase. The candy containers were refilled so that every time a participant approached the containers, they all appeared equally full.

We measured six dependent variables. First, we measured how much time (in seconds) was spent making the choice. We also measured purchase quantity (1–8) and number of unique candies chosen (1–5). Finally, to further understand the underlying choice process, we included three scale measures adapted from the previous research (Iyengar and Lepper 2000). We hypothesized that when multiple choices were allowed, then participants would not have to make trade-offs to determine their favorite, and they could choose as many varieties as they wanted. Thus, if horizontal (vs. vertical) displays yield more perceived variety, we would expect more time spent on processing the assortment, as well as greater choice ease (Townsend and Kahn 2014), choice satisfaction, and certainty (Hoch, Bradlow, and Wansink 1999) in the horizontal (vs. vertical) condition for the multiple-choice decision. When participants needed to make a single choice, the increased perceived variety would no longer be relevant, and participants would focus on finding their favorite. In this case, having to make the trade-offs to find a favorite would be more stressful (Luce 1998,) and, if anything, the higher perceived variety in the horizontal (vs. vertical) condition would be a liability. The three scale variables we included to test these hypotheses are as follows:

- Choice ease (1 = "not at all," and 9 = "extremely"; $\alpha = .62$):
  1. Did you find it easy to make your decision of which candy/candies to pick?
  2. How much did you enjoy making the decision?
  3. How frustrated did you feel when making the decision? (reverse-coded)
- Choice satisfaction (1 = "not at all," and 9 = "extremely"; $\alpha = .89$):
  1. How much do you like the candy/candies you have chosen for yourself?
  2. How satisfied do you think you would be if you eat the candy/candies you chose?
  3. How confident are you that the candy/candies will satisfy you?
- Choice certainty (1 = "not at all," and 9 = "extremely"; $\alpha = .56$):
  1. How certain are you that you have chosen the best candy/candies from the set?
  2. How certain are you that the candy/candies will be among the best you've ever had?
  3. How much do you regret choosing the candy/candies you picked? (reverse-coded)

Results and Discussion

We found no significant differences in purchase quantity among the four conditions. The overall mean number of items purchased was 4.03. In hindsight, we think that our instructions might have suggested a normal purchase quantity of 4 because we provided the following example in explaining how the payout would work: "For example, if you decide to buy 4 pieces of candy, then you will spend $1 (out of $2) and then get the leftover $1."

In spite of that, we do find our expected effects with the number of unique items chosen. Obviously, in the single-choice condition, there was no variance; by design, each participant chose only one type of candy. But in the multiple-choice condition, participants chose significantly more unique options in horizontal (M = 3.00, SEM = .10) versus vertical condition (M = 2.36, SEM = .10; $t(267) = 4.6$, $p < .0001$, $\eta^2 = .07$).

A 2 × 2 ANOVA conducted on time (in seconds) spent on making the choice revealed a significant main effect of display (F(1, 263) = 8.3, p = .004, η^2 = .03), such that participants spent more time choosing in the horizontal condition (M = 31, SEM = 1.44) than in the vertical condition (M = 25, SEM = 1.45). This main effect is consistent with our finding in the unconstrained-time condition of the eye-tracking study. There was also a significant main effect of task (F(1, 263) = 6.2, p = .01, η^2 = .02), such that people spent more time choosing in the multiple-option task (M = 30, SEM = 1.42) than in the single-option task (M = 25, SEM = 1.47). The interaction between display and task was marginally significant (F(1, 263) = 2.8, p = .09, η^2 = .01), such that difference between horizontal and vertical conditions was significant for the multiple-option choice ($M_{horizontal}$ = 35, SEM = 1.94 vs. $M_{vertical}$ = 26, SEM = 2.08; t(263) = 3.3, p = .001, η^2 = .04) but not for the single-option choice ($M_{horizontal}$ = 26, SEM = 2.13 vs. $M_{vertical}$ = 24, SEM = 2.02; t(263) = .8, p = .40, η^2 = .003). We excluded four participants when analyzing this dependent variable because the lab assistant did not record the time these four participants spent making the choice.

These results support the previous findings that horizontal displays are perceived to have more variety and require more time to choose among the options. The effect does not disappear in the single-option condition (i.e., the interaction is only marginally significant), but it is certainly mitigated when consumers are focusing on a single-option choice. The differences between the two task conditions become clearer when we study the scale measures.

The same ANOVA performed on the choice satisfaction index showed no significant main effect of task (p = .42) or display (p = .33), but we found a significant task × display interaction (F(1,267) = 6.7, p = .01, η^2 = .02). Planned comparisons showed that for the multiple-option task, the horizontal display was significantly more satisfying (M = 7.92, SEM = .15) than the vertical display (M = 7.37, SEM = .16; t(267) = 2.6, p = .01, η^2 = .02). For the single-option task, the difference in satisfaction was not significant between horizontal (M = 7.65, SEM = .16) and vertical displays (M = 7.89, SEM = .15; t(267) = −1.1, p = .26, η^2 = .0005).

The findings were similar for choice confidence. Again, there were no significant main effects, but the interaction was significant (F(1, 267) = 4.9, p = .03, η^2 = .02). For the multiple-option task, the horizontal display (M = 7.18, SEM = .14) led to higher confidence in choice than the vertical display (M = 6.60, SEM = .14; t(267) = 2.9, p = .004, η^2 = .03). For the single-option task, the difference was not significant between horizontal (M = 6.83, SEM = .15) and vertical displays (M = 6.88, SEM = .14; t(267) = –.3, p = .79, η^2 = .0003).

For the choice ease index, there was a significant main effect of task (F(1, 267) = 3.9, p < .05, η^2 = .02), such that the multiple-option task was seen as easier (M = 6.79, SEM = .12) than the single-option task (M = 6.44, SEM = .13). Although the interaction was only marginally significant (p = .10, η^2 = .01), within the multiple-option task the horizontal display (M = 7.04, SEM = .17) was seen as easier than the vertical display (M = 6.55, SEM = .18; t(267) = 2.0, p = .04, η^2 = .02), whereas within the single-option task, there was no difference across horizontal (M = 6.40, SEM = .18) and vertical displays (M = 6.49, SEM = .17; t(267) = −.3, p = .75, η^2 = .0004).

Overall, these results show that when perceived variety was a relevant concern, as it is when choosing multiple options or more than one flavor is the norm, horizontal displays yielded more unique options chosen than vertical displays. In addition, in the multiple-option task, participants were more satisfied, were more confident in their choices, and found a greater ease of making the choices through horizontal versus vertical displays. These effects were not evident in the single-option task, in which participants focused on finding their favorite item. When people choose a favorite option, variety is only relevant insofar as it can ensure that one's favorite is present.

GENERAL DISCUSSION

Through a series of five studies, both lab and field experiments, we have demonstrated that when choice situations allow for multiple options or multiple variants to be selected, more variety is chosen (as measured by number of unique options selected) in horizontal displays than in vertical displays. When the number of options chosen is not fixed, it results in more options overall being chosen from horizontal displays relative to vertical displays. Through a lab study and an eye-tracking study, we have found support for at least part of the underlying processes that help explain why this effect occurs. During initial scans of assortments, horizontal (vs. vertical) displays are easier to process due to a match between the binocular vision field (which is horizontal) and the dominant direction of eye movements required for processing horizontal displays. This processing fluency allows people to more efficiently browse information in a given time, which increases the perceived variety of the horizontal (vs. vertical) assortments. Although these processing fluency advantages dissipate with longer processing time, the perceptions of higher variety linger, resulting in larger consideration sets in horizontal (vs. vertical) assortments. More extensive processing is then needed at the choice stage, or when time is not constrained, to ruminate on the options, and this results in larger choice sets or more unique options chosen in horizontal (vs. vertical) assortments. We have also identified a boundary condition whereby the differences between horizontal and vertical displays evaporate during the choice of a favorite single option among familiar alternatives because perceived variety is no longer relevant or necessarily beneficial.

Because horizontal displays can make it easier for consumers to scan the entire assortment and perceive the assortment variety, we recommend horizontal assortment displays be used in product categories for which it is common or desirable to purchase more than one item within the category. In this case, horizontal displays can increase variety seeking and thus purchase quantities, as our shopping mall field study has shown. In product categories for which consumers are more likely to make trade-offs and purchase only one item, horizontal presentation of options might not be the best strategy. Although our current results show no difference in choice ease, satisfaction, or confidence between horizontal and vertical displays when only a single option is considered, we do see some directional support that indicates vertical assortments might be preferable in this context. For example, it is possible that vertical assortments are more likely to cue hierarchical inferences, making choosing one item easier. We leave investigation of this idea to future research.

Our research contributes to several areas of research in marketing. First, the literature on consumer assortment perceptions has shown that perceived assortment variety is affected by various factors such as assortment structure (Hoch, Bradlow, and Wansink 1999; Kahn and Wansink 2004), allocated shelf space (Broniarczyk, Hoyer, and McAlister 1998), presence of high-preference items (Broniarczyk, Hoyer, and McAlister 1998), partitioning of the assortment (Mogilner, Rudnick, and Iyengar 2008), and visual versus verbal display (Townsend and Kahn 2014). We add to this literature a new factor: horizontal versus vertical assortment display.

This literature has been interested in dependent variables such as consumers' store choice (Broniarczyk, Hoyer, and McAlister 1998; Hoch, Bradlow, and Wansink 1999), assortment preference (Townsend and Kahn 2014), satisfaction (Hoch, Bradlow, and Wansink 1999; Mogilner, Rudnick, and Iyengar 2008; Morales et al. 2005), and consumption quantity (Kahn and Wansink 2004). We add to this body of work by showing that horizontal versus vertical assortment display can affect processing fluency and efficiency, assortment variety perceptions, and size of consideration sets, which in turn affects number of options and number of unique options chosen.

More broadly, our work contributes to the literature studying the effects of in-store visual factors on consumer processing and decision making. There, researchers have looked at factors such as shelf space (e.g., Inman and McAlister 1993; for a review, see Campo and Gijsbrechts 2005), number of shelf facings (Chandon et al. 2009; Drèze, Hoch, and Purk 1994), and horizontal and vertical shelf positions (Chandon et al. 2009; Drèze, Hoch, and Purk 1994; Valenzuela and Raghubir 2009; Valenzuela, Raghubir, and Mitakakis 2013). Most related to our research is the work of Chandon et al. (2009) and Valenzuela, Raghubir, and Mitakakis (2013) on horizontal and vertical shelf positions. Their findings show that a particular product's position relative to other products on the shelf can influence how customers evaluate the product. Our work is different in that it shows that whether an array of products is scanned horizontally or vertically affects processing fluency, perceived variety, and choices.

Results from our studies provide important managerial implications. Although horizontal and vertical assortment displays as visual merchandising techniques are widely and easily used in retail settings, their effects on consumer processing and decision making are largely unknown to managers. Given that assortment variety is one of the critical factors that attract consumers to a (physical or online) store (Broniarczyk and Hoyer 2010), findings from this research suggest to retailers that horizontal assortments can be used to promote perceived assortment variety.

In particular, our results suggest that horizontal displays should be used when variety is a strategic aspect of the category and when the retailer wants to make the variety more salient, which could then lead to increased purchase quantities. For example, in candy or yogurt categories, for which variety is an asset and multiple purchases are common, horizontal displays should make the variety easier to process and should increase purchase quantities. In these categories, different flavors are frequently priced equivalently, which, again, should help encourage increased purchased quantities. In contrast, in purchase decisions in which consumers are likely to choose only one item at a time, such as when prices or sizes vary, then vertical assortments should be more compelling because they de-emphasize variety. In these cases, horizontal displays that allow consumers to process more variety might be confusing and thus make the choice among the options more complicated.

As retailing increasingly moves to the mobile interface, there may be further implications about what factors will moderate our results. In a mobile or tablet environment, product assortments can easily be oriented either horizontally or vertically. Furthermore, horizontal and vertical orientations can be simulated by viewing products from either a landscape or a portrait perspective as consumers flip their devices from one angle to another. Future research might investigate whether our results would generalize to these new types of retail platforms.

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AUTHOR QUERIES

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There are no queries in this article.