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Swipe, Scroll, Add-To-Cart: a case study of e-commerce gallery designs for small screen devices

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Abstract: With significant increase in mobile online shopping the design of user experiences that promote purchaser decisions and increase sales is highly desirable to retailers and their marketing and digital production companies. Surprisingly little investigation into the usability of product galleries is available to guide the design of product listing pages for e-commerce websites, especially those websites viewed on small screen devices. Our research takes a synergistic view of the design and usability literature and provides a visually guided case study of e-commerce websites on mobile devices. We offer initial guidance to designers based on the insights from a heuristic analysis of current design trends of e-commerce websites viewed on a mobile device.

Keywords: e-commerce; mobile web; product display; gallery design

1. Introduction

It has long been known that presentation of information and products for users will influence purchasing behaviour in both digital (Blanco, Sarasa, & Sanclemente, 2010; Liao, To, Wong, Palvia, & Kakhki, 2016) and non-digital contexts (Ares et al., 2013; Childers & Houston, 1984; Percy & Rossiter, 1983). With the increase in mobile shopping (“Shopify Announces First-Quarter 2018 Financial Results,” n.d.) the design of quality usable product presentations in e-commerce features of digital libraries as well as websites is critical. One such opportunity to present products is the gallery of an e-commerce website which often functions as the showroom or product catalogue of the digital age. Exploration of the existing body of work highlights the lack of guidance in the visual structuring of e-commerce galleries.

Presentation of information (Kim & Sundar, 2016; Vanderschantz, Timpany, & Hinze, 2015) and interaction with that content (Vanderschantz, Timpany, & Feng, 2018a, 2018b; Wei, Chang, & Cheng, 2015) on small screens is problematic in a number of contexts and is a common feature of the HCI and digital library literature. The presentation of interactive



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visual information that we describe in this paper provides insights for designers of websites, mobile apps, and digital libraries that contain e-commerce and non-e-commerce gallery presentations of products.

This study focuses on the presentation of fashionwear in website galleries on mobile devices because e-commerce is an often-reported pain point in the fashion industry (Møller Jensen & Hansen, 2009; Parker & Wang, 2016; Rodgers & Harris, 2003). Clothing items are often considered a difficult product to sell online due to consumers' perceptions of risk and inconvenience (Dittmar, Long, & Meek, 2004; Møller Jensen & Hansen, 2009; Rodgers & Harris, 2003). Consumers' reported risk and inconvenience are due to the inability to try clothing items on coupled with the lack of personal advice while shopping online. We hypothesize that designers need to find methods of displaying products and communicating product information in order to bridge this gap between purchasers and e-commerce providers (Dittmar et al., 2004; Ulbrich, Christensen, & Stankus, 2011). We identify four common interface design metaphors and give recommendations for the design and further testing of e-commerce galleries on mobile devices.

2. Related Work

While there has been a plethora of studies that have looked at various aspects of e-commerce design, there has tended to be a focus on the overall aesthetic design, home page design, or product detail page design, rather than research regarding e-commerce gallery design. Our research is concerned with the product listing pages of e-commerce websites, that is to say, web pages that provide a list or gallery of available products. We distinguish product listing pages from other pages in e-commerce websites, such as home pages and product detail pages. Home pages are well established as the storefront of an e-commerce website and typically provide brand and service information for a store. Product detail pages are the pages a user is presented when they select an item from a gallery or list provided on a product listing page. These product detail pages provide garment specific information about the product to assist with purchasing decisions.

We will discuss the related work on e-commerce web page design and highlight the areas of research needed with specific reference to product listing pages. We will focus our reporting to related work that considered visual design and usability design of e-commerce web pages and their impact on purchaser behaviour.

2.1 Product Listing Page design

Of the study's conducted on product listing pages, most only look at the differences between a list design versus a matrix grid style (Flavián, Gurrea, & Orús, 2009; Hong, Thong, & Tam, 2004b; Schmutz, Roth, Seckler, & Opwis, 2010). Lal (2013) suggests either style should be used while keeping a vertical scroll format as best practice in e-commerce. Both Hong et al. (2004b) and Schmutz et al. (2010) suggest that the list format is better for comparison tasks because products are presented close together. Lists also reduce the information and

product search time while aiding information recall on desktop devices (Hong, Thong, & Tam, 2004a; Hong et al., 2004b). However, the vertical stacking of lists on restricted screen sizes results in the consumer needing to scroll and can diminish ease of comparison and increase browsing time (Flavián et al., 2009; Hong et al., 2004b).

When a consumer is browsing the matrix format can create more effective information search and product recall. This is likely because images increase the speed with which a consumer can locate a product in a list when they already know what the product looks like (Hong et al., 2004a). However, images in a list can be too small for fashion items to help purchasing decisions (Tupikovskaja-Omovie, Tyler, Dhanapala, & Hayes, 2015). Images should be big enough to see important details but not impact download time (Nielsen, Snyder, Molich, & Farrell, 2001).

Hong et al. (2004b) suggest detecting the type of task the user is trying to fulfil in order to determine if a list or matrix format should be shown. However, (Schmutz et al., 2010) cautions against this technique as the method of detecting a user's intended task is difficult to achieve and may not be accurate. An alternative would be to provide the consumers the ability to switch between the two formats through a button.

Spacing of products require attention. Where product images are visually close together, consumers will be less successful at keeping their attention on the focal product (Juanéda, Sénécal, & Léger, 2018). However, where distractor items and the focal product are similar, there is a positive impact on accuracy during decision tasks and could explain why consumers can have a positive attitude towards websites when a list layout is used (Hong et al., 2004b). An interesting investigation by Fu et al. (2018) discovered that designers tended to prefer interfaces with low density spacing of products, while consumers preferred high density interfaces with tightly spaced product images or lists.

The number of products included in a store can have a large effect on cognitive load, where the catalogue of products is small, the layout has little effect as there is usually less scroll required to view and compare products. Flavián et al. (2009) suggest that in large product catalogues consumers struggle with comparison tasks and tend to prefer a matrix layout as it makes processing information and comparing products easier. Contradicting this (Hong et al., 2004b; Schmutz et al., 2010) suggests that the list format facilitates the comparison task more so than the matrix layout.

Further research that has considered the design of the product listing page has included the prototype design of one-page visual catalogue based on information visualization techniques (Lee, Lee, & Wang, 2004) while Zhang et al. (2017) tested different ways of arranging product information in list view designs. Other studies that focused on this page looked at the effect of the order of products listed (Cai & Xu, 2008; Y. Xu, Cai, & Kim, 2013; Yan-Kwang, Chiu, & Yang, 2014).

Even given the work we highlight here; few studies have made clear recommendations for the visual or usability design of product listing pages. Especially lacking are recommendations for small screen product listing page designs.

2.2 Product Detail Page Design

There is a large focus in the literature on the product detail page, with guidelines on how to design various aspects of that page. While our study does not focus on the design of product detail pages the findings of this work are applicable. One widely accepted design guideline for product detail pages is the inclusion of a product image. Images provide visual as well as textual information, both of which are thought to be critical to assist decision making (Blanco et al., 2010; Hong et al., 2004b; Liao et al., 2016). Where high information load occurs, visual based product presentation modes are recommended when presenting product information to consumers (Li, Wei, Tayi, & Tan, 2016). Hong et al. (2004b) showed that use of a product image beside a brand name or brand mark assists with memorability and product name recall. Video formats have also been suggested to be more effective where products are deemed experiential goods, such as clothing (P. Xu, Chen, & Santhanam, 2015).

2.3 Design & Usability Evaluation

Research into design, human-computer-interaction, and usability have often been co-located in inter-related or semi-autonomous research spheres. While at times the individual literatures can be found using similar jargon in different contexts, in the design of digital technologies the observations from each field must be acknowledged and drawn from.

Design and usability research providing guidance for the development of product listing pages on small screen devices is missing from the literature to date, however, general design guidelines for small screens include:

- Keep the design simple (Lobo, Kaskaloglu, Kim, & Herbert, 2011; Shitkova, Holler, Heide, Clever, & Becker, 2015)
- Simplify user input (Lobo et al., 2011)
- Keep to vertical scrolling (Evelhoch, 2016; Lobo et al., 2011; Shitkova et al., 2015; Yu & Kong, 2016)
- Use multiple versions of the website (Cazañas & Parra, 2016; Lobo et al., 2011) via responsive/breakpoints or separate mobile sites
- Choose between native apps or mobile web apps (Lobo et al., 2011)
- Optimise navigation for mobile usage (Garcia-Lopez, Garcia-Cabot, Manresa-Yee, de-Marcos, & Pages-Arevalo, 2017; Lobo et al., 2011; Shitkova et al., 2015, Vanderschantz & Yang, 2019)

Commonly both the design and usability evaluation literature refer to a set of general design guidelines and usability heuristics, usually the heuristics outlined by Nielsen (1994). As the adoption of mobile devices increases, so has the research on adapting common usability heuristics, such as Nielsen's to fit with the usability needs of smaller screen devices (i.e. Inostroza, Rusu, Roncagliolo, Rusu, & Collazos, 2016; Thitichaimongkhon & Senivongse, 2016; Yáñez Gómez, Cascado Caballero, & Sevillano, 2014). Updates to Nielsen's original heuristics have been proposed by Thitichaimongkhon & Senivongse (2016) and Yáñez Gómez et al. (2014) who proposed inclusion of *privacy* heuristics as well as interactions that are

pleasurable and *respectful*. These proposed privacy heuristics consider data and information security while *pleasurable* and *respectful* heuristics consider typographic presentation and ease of form filling on mobile devices. Additionally, Yáñez Gómez et al. (2014) proposed the *skills* heuristic which is equivalent to Nielsen's (1994) guidelines regarding *flexibility* and *efficiency*. While Nielsen's heuristics (1994) were designed with software in mind, these guidelines are applicable to website design on mobile devices to this day.

3. Method

We conducted a case study that was used to analyse the current designs of fashion-oriented e-commerce websites on a small screen device. Due to consumers perceptions of risk and inconvenience related to online fashionwear shopping (Dittmar et al., 2004; Møller Jensen & Hansen, 2009; Rodgers & Harris, 2003) this case study focuses on the product listing pages to determine how they are designed for mobile devices and what pain points for users may exist. Our review of the related work (see Section 2.1) has shown that few studies have made recommendations for the design of product listing pages, especially in the context of small screen devices. Therefore, our case study was designed to fill this gap in the literature and in so doing reveal insight into present design conventions and usability issues related to the presentation of e-commerce gallery's on mobile devices. We argue that before adapting or developing suitable layouts for testing it was important to first provide evidence of current practice to guide future development. Given the findings of this case study designers and researchers will be equipped to develop suitable e-commerce galleries and new design solutions based on evidence of current practice which is not currently available.

3.1 Sampling Procedure

Following the advice of Fu et al. (2018) on the 6th of November 2018 we conducted an internet search with the following five search queries; *best fashion websites 2018*, *best fashion eCommerce website 2018*, *Popular fashion eCommerce*, *best design fashion website* and *best online shopping sites for women's clothing*. At the time of this study Google had a 90% market share of search engine use (*Search engine market share worldwide 2019, 2020*) and thus we conducted our searches using only the Google search engine. We used the results of this web search to identify 10 online lists of fashion websites that appeared across all five of those search queries. From these 10 lists we selected, documented, and reviewed 12 websites that were common across those 10 lists. All reviewed websites appeared at least three times across the lists.

3.2 Heuristic Evaluation Tool

Our review of the related work (see Section 2.3) has shown that numerous researchers have proposed guidelines for the development of small screen interfaces that build on Nielsen's work, however, Nielsen's (1994) heuristics remain most suitable for the evaluation of website features even on small screen devices. When conducting the test with each website of

browsing the ‘dresses’ category and adding a summer dress to the cart we used each of Nielsen’s usability heuristics (see Table 1) to evaluate each website. Our analysis and heuristic evaluation reported here applies only to the product listing page.

Table 1 *Heuristic evaluation criteria*

Heuristic	Evaluation topics
User control	Consumers ability to organize and filter products Layout impedes/enhances completing shopping tasks
Flexibility	Consumers have multiple ways to complete shopping tasks
Minimal Design	A Minimal design was used Small screen devices were considered Layout impedes/enhances completing shopping tasks
Feedback	Feedback indicating actions were completed
Error Recovery	Consumers can recover form accidental actions Layout impedes/enhances error recovery
Error Prevention	Website prevents errors happening Layout impedes/enhances error recovery
Users’ Language	Language used matches consumers language
Consistency	Consistency within and across websites Layout impedes/enhances consistency
Recognition	Layout impedes/enhances recognition
Providing Help	Help features are provided Location of help features

3.3 Study Procedure

The study was planned and developed by two researchers who both have a background in the design, development, and evaluation of user interfaces. The two researchers agreed upon the search method and evaluation process. An initial evaluation of a website not included in the study was undertaken by both researchers to ensure agreement with the process and evaluation criteria. A single researcher undertook the sampling procedure (see Section 3.1) and the study walk-through (see Section 3.2). Early in the analysis phase, confirmation of mutual agreement was achieved through the discussion of a sample of the websites identified to ensure agreement was achieved regarding the classifications of the websites and usability issues encountered.

3.4 Apparatus

All websites were viewed in the Chrome web browser on a Xiaomi Mi A1 running Android 8.1.0. This device has a screen size of 5.5 inches and was set to full HD (1080P) resolution. We tested each website with the task of browsing through the ‘dresses’ category on the website to find and add a summer dress to the cart. During this process, screenshots of the

homepage and the product listing page of each website were taken to allow for additional evaluation of the designs on a desktop computer using Preview (an image viewer by Apple Inc.). These screenshots provided records of the design should changes have occurred on the websites after the analysis was undertaken. Additional analysis of the websites through screenshots allowed us to see what was visible at given points along the process of browsing and purchasing of items. Screenshots were also used to determine any additional usability issues with the interface that may have been missed in the initial evaluation walkthrough.

4. Results

We detail the results of our case study analysis. This section encompasses the visual design of product listing pages for fashion websites as well as a heuristic analysis of the usability of these webpages on a mobile device.

We identified four methods for presenting product galleries. We have called these: Symmetrical Matrix (see Figure 1 A), Asymmetrical Matrix (see Figure 1 B), Large Product (see Figure 1 C), and Swipe and Scroll (see Figure 1 D). We found no websites that presented a product list view. Table 2 provides an overview of the sizes of the product catalogues that we studied and the design metaphors that were implemented.

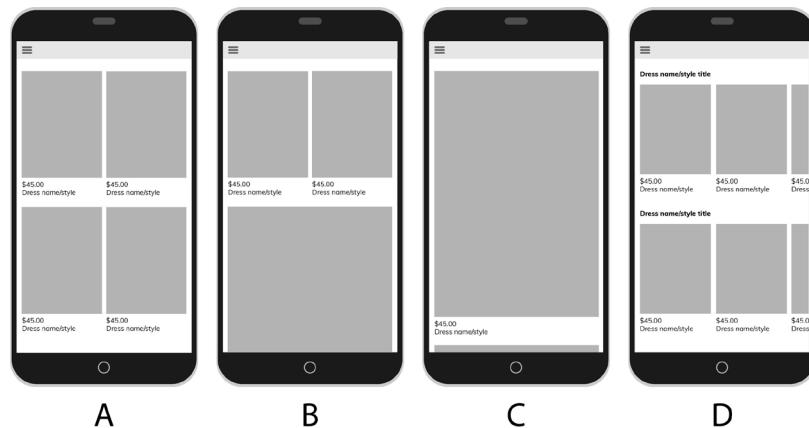


Figure 1 Four metaphors of gallery interface design, (A) Symmetrical Matrix, (B) Asymmetrical Matrix, (C) Large Product, (D) Swipe and Scroll

Table 2 Product Catalogue Sizes of Websites Analysed
 (*Table 2 records results for 13 websites instead of 12 because one website allowed the user to switch between Symmetrical Matrix presentation and Large Product presentation)

Layout Metaphor	0-5k	5k-10k	10k-15k	15k-20k	20k-25k	25k-30k	30k +
Symmetrical Matrix	2	3	-	3*	-	-	2
Asymmetrical Matrix	1	-	-	-	-	-	-
Large Product	-	-	-	1*	-	-	-
Swipe & Scroll	1	-	-	-	-	-	-

The Symmetrical Matrix (see Figure 1 A) is a traditional layout commonly seen within e-commerce where products were organized in a grid, usually containing two columns. Ten of the websites analysed utilized the Symmetrical Matrix layout. It can be seen in Table 2 that two of these websites that used Symmetrical Matrix designs had catalogues of less than 5,000 products, three websites had catalogues with 5,000 to 10,000 products, with another three websites with 15,000 to 20,000 products, while two websites that used Symmetrical Matrix's had product catalogues of more than 30,000 products. One website broke the two-column mould by utilizing a three-wide grid. Websites using this metaphor had catalogues ranging from very small (83) to very large (70K+).

The Asymmetrical Matrix (Figure 1 B) layout used a similar two column grid to the Symmetrical Matrix with featured product images that were scaled to fit the full width of the screen. Only one website analysed used this gallery metaphor and had a smaller catalogue size of less than 5,000 products (see Table 2).

One website used the Large Product (see Figure 1 C) layout which consisted of products which were displayed the full width of the screen. Each product was listed one after the other. This same website offered the user the option to switch between the Large Product metaphor and the Symmetrical Matrix metaphor using a menu item towards the top of the page. This was the only website that offered multiple methods to interact with the product listing page and had a large product catalogue of 15,000 to 20,000 products (see Table 2).

Finally, one website used the Swipe and Scroll (Figure 1 D) metaphor where the variations of a product style (such as The Cashmere V neck sweater) were grouped together in a container that could be scrolled sideways. The website utilizing this style had a small catalogue size of less than 5,000 products (see Table 2).

4.1 Usability

Eleven of the websites had designs which appeared to be designed with a mobile screen in mind. These appeared to either use responsive layouts or media queries to create designs suitable for where there is less screen real estate available. One of the Symmetrical Matrix websites had a layout that was not optimised for a smaller screen (see Figure 2). This design was very hard to use as navigation, filter, and menu items were smaller than the user's finger; leading to interaction errors.

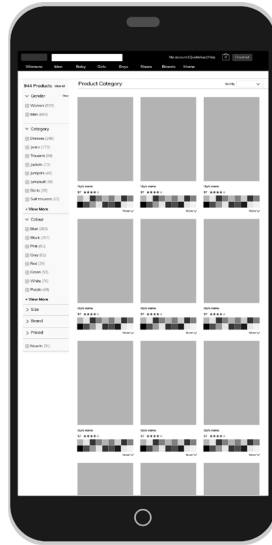


Figure 2 A Symmetrical Matrix layout that was not optimized for small screen devices

Techniques used to maximise the screen space included having filter menus appear when needed and menu bars shrinking to the top of the screen or off the screen completely (see Figure 3 B & C). Both techniques allow larger thumbnail images. Where menus moved above the screen, initial confusion may occur, however, the learning curve is likely short. Scrolling up slightly results in the menu appearing again.

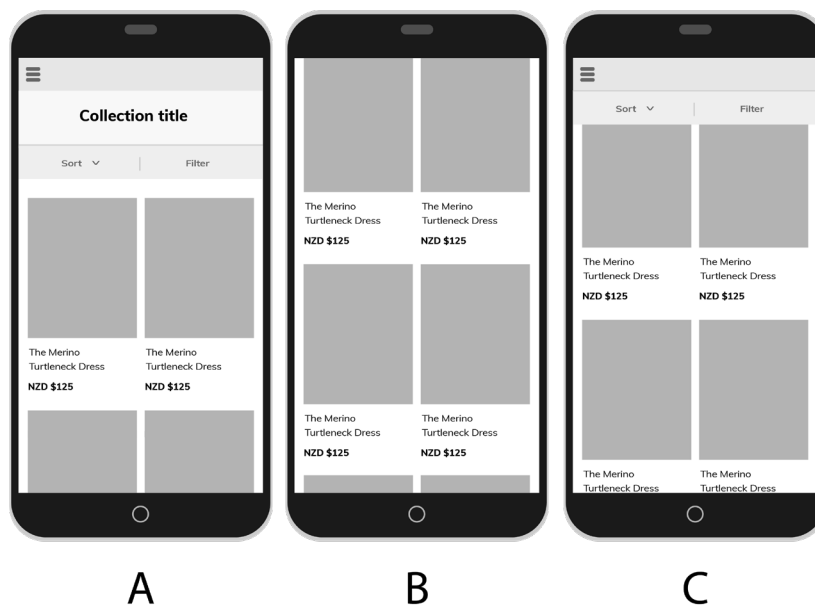


Figure 3 Header menu behaviour before scrolling down (A), off screen due to scrolling (B), minimized due to scrolling (C)

Frustration levels of consumers is of concern for website development. Ten of the twelve websites would be likely to cause little frustration, presenting little to no issues. The few identifiable usability issues were; no back to top when scrolling through items or having to figure out how to access the menu bar. Those types of issues were small and could be easily

worked around. Only five websites included a back to top button when browsing through the items in the company's product catalogue. Of the remaining seven websites, five had a large product catalogues (15,000 products or more) and required significant scrolling.

USABILITY HEURISTICS

For the most part, the websites we analysed were designed in line with the guidelines set out by Nielsen (1994). Where websites failed a guideline, these tended to fall into the User control, Error prevention, Flexibility and Minimal design heuristics. All websites did well in the aspects of Feedback, User's language, Consistency, Recognition, Error Recovery and Providing Help.

User control: The websites that failed the user control guideline tended to be due to a lack of search or filtering options. Two of the Symmetrical Matrix and one of the Asymmetrical Matrix failed the user control guideline. For large catalogues the issue is more severe making it harder to narrow products down. However, the lack of filtering in a category had less impact on the consumers where a smaller number of items appeared in a catalogue. User control was impeded on the Large Product metaphor due to the nature of large scrolling required to complete shopping tasks. This would make comparison tasks harder for consumers to complete.

Flexibility: All websites provided multiple ways to interact with items or complete tasks. Shortcuts provided were generally global search of products (10/12) and filtering (11/12) of items. Websites which did not have these features (2/12) forced consumers to interact how the website wanted, instead of the consumers preferred way. The one website that provided both a Symmetrical Matrix and Large Product layout allowed consumers to browse products in their preferred layout.

Minimal Design: Minimal design was a guideline that only one Symmetrical Matrix website failed to meet. As seen in Figure 2, by displaying all elements of the website such as filtering on the screen constantly, the interface appeared cluttered and reduced the overall physical size of the elements on the screen. It appeared that little consideration was given to maximising the available screen real-estate. While the Large Product metaphor website had a very minimal design consumers were required to scroll significantly to view all products.

Feedback, Error prevention and recovery: Feedback was commonly given when a consumer added an item to their cart or wish list. A small number indicator was placed within the cart icon (see Figure 4 B) and occasionally beside the icon (Figure 4 A) to indicate the action had completed successfully on all the websites reviewed. When adding items to a wish list the icon usually swaps from an outlined to filled icon, often with a micro animation to draw attention (Figure 5).

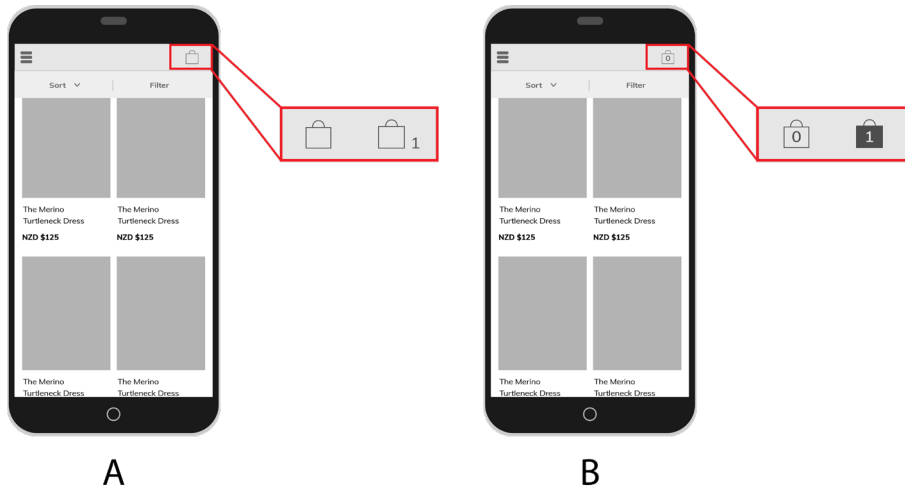


Figure 4 Indicator of items in the cart: Number indicator next to icon (A), Number indicator within icon (B)

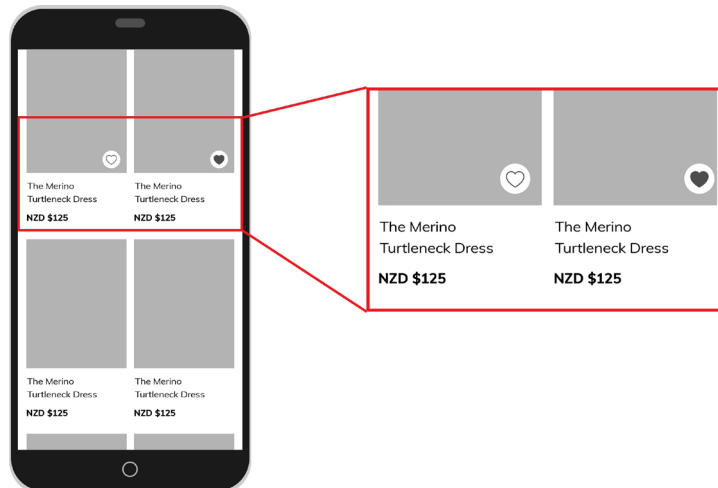


Figure 5 Favourites icon before and after adding item to the wish list

Textboxes would have validation to confirm the correct input type was used. This validation was completed as a consumer typed, allowing the consumer to quickly fix errors, which ensured speed of error correction. Websites would occasionally also force a numerical keyboard where a numerical value was required. The Swipe and Scroll layout was most likely for consumers to make the error of missing products. To minimize this, a large portion of the partially visible item was shown to prompt horizontal swiping (see Figure 6).

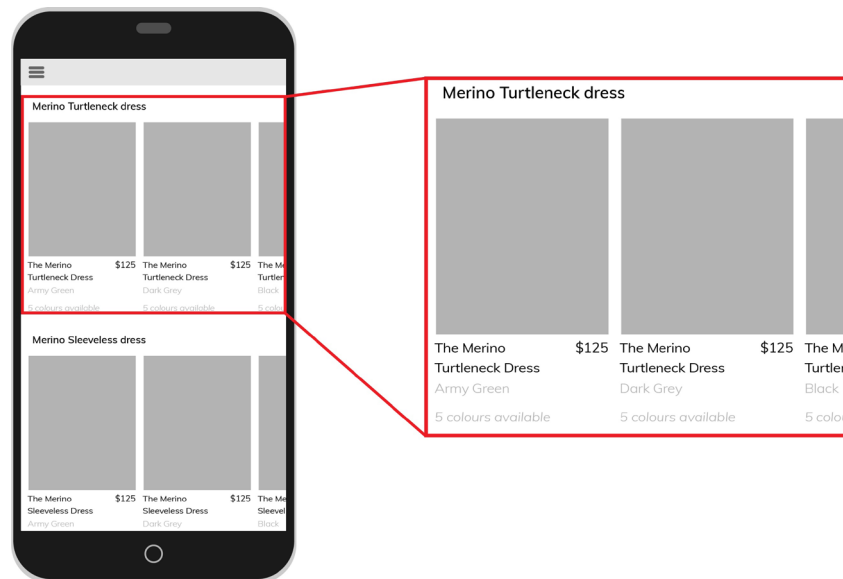


Figure 6 Partially visible product indicating side scrolling functionality

Users’ Language: The language used across the websites included common terms used by fashion consumers. Terms varied slightly between brands, alternate terms were similar and ensure that consumers could quickly determine what a term meant (see Table 3).

Table 3 Examples of similar terms used across websites

Term	Terms used
Product Range	Collection, Product Category
Clothing shape	Style, Shape
Curated collections	Shop the Edits, Shop by Trend, Trends

Consistency and Recognition: Standard conventions of the information provided to a consumer of e-commerce product catalogues was identified. Typical information included a product image, title or short description and price. As noted in Section 4.1 the websites all used a familiar matrix grid design, along with a standardised mobile layout. The use of consistent design conventions within the layout and catalogue design will also aid ease of use for consumers and ensure low learning curves from one website to another. The Swipe and Scroll layout was the only design for which a learning curve would occur.

Providing Help: While the websites provided help features within their pages, this was not seen within the product gallery pages. These were usually found in the sitewide footer menu or located on the individual product listing pages. The most common forms of providing help was providing frequently asked questions (FAQs) and providing sizing chart information.

5. Discussion

Our analysis of 12 highly rated e-commerce websites has identified four different gallery metaphors. The symmetrical matrix was the most implemented product listing page design in 10 out of 12 of the analysed websites. We hypothesize that this may be due to the prevalence of e-commerce platforms (such as Shopify) providing free templates that typically come with the symmetrical matrix design as a default. Equally, as this format is a common feature of wider web-design visual language this metaphor may be expected by consumers and thought by developers to provide consistency and recognizability. The research shows that a matrix is better suited for most situations (Flavián et al., 2009; Hong et al., 2004b) and is particularly suited for small screens as more products can be seen at once compared to list views (Hong et al., 2004b).

We suspect that large products in the Asymmetrical Matrix and the Large Product may become a frustration point for consumers. Large product images are a useful visual feature in galleries because consumers can see the clothing items in more detail at larger sizes, but this comes at a cost of a longer scroll to view more products. Coupled with a lack of filtering or return to top functionality in large catalogues this usability hinderance may impact sales.

The Swipe and Scroll was a unique method to display multiple variants of a product. The nature of grouping them together in the horizontal scrolling container meant that consumers could see the available colourways of items or could continue to scroll vertically if uninterested. This may reduce the number of products a consumer is required to scroll vertically passed when browsing a product because repetition of products in different colours is not necessary. The unfamiliarity of two-dimensional scrolling, which goes against the advice of using pages that scroll vertically (Lal, 2013), may lead consumers to miss products they may have easily seen in other layouts.

The Large Product layout would appear to work well for smaller product catalogues rather than large product lines. This suggests that the size of a brands product catalogue may dictate the style of gallery they should use to be most effective. This may be one reason that the Symmetrical Matrix was so prevalent amongst the websites analysed.

We did not identify a List metaphor used for product listing pages by any of the websites we reviewed. We would have considered a product listing page to be using a List metaphor if it presented results using only text in a formatted list presentation (see Figure 7 A) or text accompanied by a small graphic in a formatted single column presentation (see Figure 7 B).

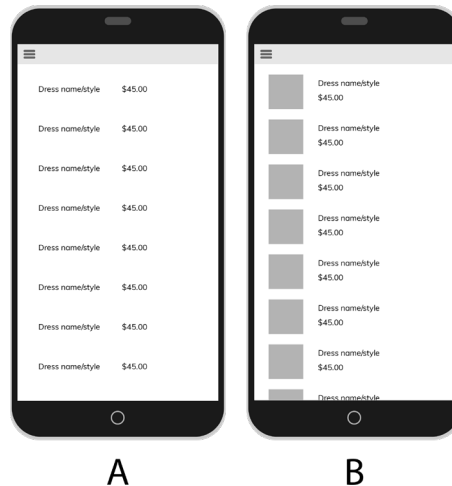


Figure 7 Two metaphors of List View gallery interface designs, (A) Text-only, (B) List with thumbnail

This preference for a gallery metaphor for product listing pages by fashion retailers is not surprising given that numerous researchers (i.e. Blanco et al., 2010; Hong et al., 2004b; Liao et al., 2016) report the importance of images in e-commerce websites. The gallery metaphor use that we identify in our case study is in line with recommendations by Hong et al. (2004) who suggested that galleries are superior to lists for browsing by users because galleries improve information search and product recall. This use of galleries over lists also reinforces Tupikovskaja-Omovie et al.'s (2015) findings that purchasing decisions regarding fashion items requires larger images than List views typically provide.

5.1 Recommendations

We provide the following recommendations for the design of e-commerce galleries in either websites or digital libraries based on our findings from the related work and our heuristic analysis.

Familiarity: If a very familiar layout is desired for an e-commerce store, the Symmetrical Matrix design is likely to be common across websites that consumers visit. The Symmetrical Matrix will have a low learning curve for users and can facilitate a wide range of catalogue sizes.

Catalogue Size: The number of items in a company's product catalogue compounded the noted screen real-estate issues on mobile devices. This suggests that the size of a brand's product catalogue may dictate the style of gallery that will be most appropriate. We would caution against the use of the Large Product metaphor as the primary gallery design for a large catalogue. For a smaller catalogue the Large Product metaphor might provide the illusion of a more sizable catalogue due to the increased need for scrolling to view products.

Vertical and Horizontal: Horizontally scrollable containers of products are not a new concept. Horizontal scroll may offer potential benefits of reducing choice overload and shopping

efficiency through a reduced number of products shown to the consumer overall. This may also serve to offer colourway, or product variation choices to consumers quickly and efficiently. The concern with this technique is that learnability may be an issue and there is a chance that consumers may miss products if they are not familiar with this interaction design.

Back to top: For all gallery sizes we would recommend a suitably implemented Back to top button. This device was found to be critical on galleries with large product catalogues and especially for galleries that implemented the Large Product metaphor.

5.2 Future work

Our work here nor the related work has yet fully assessed implications of user preference and user success with product galleries on e-commerce websites. Further work regarding user preference, user success, and purchaser behaviour using mobile e-commerce galleries is required. Specifically, for galleries, the minimum size of product images for both usefulness when identifying a product and usability during touch interaction requires investigation across all of the gallery metaphors that we have identified. Importantly, investigation of the implications and effects of gallery metaphor on purchaser behaviour is required. We recommend user observation studies that test both the gallery metaphors that we have identified as well as novel user metaphors developed for e-commerce.

6. Conclusion

Facilitating ease of swipe, scroll, add-to-cart e-commerce anywhere and anytime is a primary goal for retailers across many industries today. We focus our investigation here on the fashion industry with a heuristic case study of e-commerce product listing page designs for small screen devices. Our inter-disciplinary review of the related work identified surprisingly little advice for the successful user experience design of website, digital library, or mobile app galleries to guide the design of product listing pages for e-commerce. A significant feature of our case-study is that we have identified, classified, and labelled four design metaphors for mobile gallery designs. All e-commerce fashion websites reviewed used a gallery metaphor, with no list designs used for this genre of e-commerce website. Further, we have used a usability heuristic evaluation to offer initial guidance to designers to implement *Symmetrical Matrix* interfaces which will align with the common visual language of e-commerce websites today. Finally, we identify specific investigation needs for designers and developers to better understand user preference and user success with e-commerce galleries.

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