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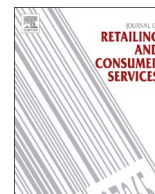
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## Inside-outside: Using eye-tracking to investigate search-choice processes in the retail environment



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### ABSTRACT

In the retail environment, attention is requisite to purchase, attention being the collection and assessment of stimuli from our senses (visual stimuli are generally the most important) for cognitive processing according to the needs of the moment. Visual attention is easily and affordably measured today using eye tracking technology. This paper reviews the “state of play” of the use of eye tracking technology as a research tool in retail and retail marketing. The review is timely as during the last decade many non-proprietary eye tracking studies have been published in marketing, consumer behavior, and retail journals, and additional work is expected as the technology gains adoption in consumer research. We reviewed studies that contributed to an understanding of consumer behavior in the gold standard of consumer interface: the retail store. The goal of the paper is to provide a synthesis of retail-focused eye tracking study findings. We present the managerial and theoretical significance of the research as well as an agenda that considers the use of eye tracking from pre-shopping through point of sale.

### 1. Introduction

Attention is the process by which stimuli are selected and integrated for cognitive processing (Phaf et al., 1990) and is an important element of the purchasing process, if only to locate an item in a display or on a shelf. While information is gathered from all our senses, a significant part of the brain is devoted to visual processing (Hagen, 2012), and understanding how visual information is obtained and cognitively processed is useful in many contexts. Attention is often necessary to complete a task, and for the retailer, the essential task is to capture and direct consumer attention to cues or information that ultimately lead to purchase.

Eye tracking (ET) technology has made investigations of consumer shopping and decision making more accessible and affordable. ET has been used to investigate a variety of topics in retail marketing, including packaging (Chandon et al., 2009), display elements (Behe et al., 2015), and in-store signage (Otterbring et al., 2014). Despite the prevalence of online shopping, the retail store remains an extremely important consumer interface; our goal was to synthesize how ET technology is being and could be used to inform the understanding of consumer behavior in the real environment of a retail store.

Intriguingly, a number of online retailers are recognizing the importance of a physical presence and are developing a physical retail presence—Amazon and Shoes of Prey are two examples from opposite ends of the size spectrum. Clearly the days of “realtail” are not yet over.

In comparison to a laboratory setting, a store is complex and full of stimuli deliberately integrated by the retailer. Displays, sounds, and even scents are all designed to attract and often compete for a customer's visual attention to a category, temporary display or product range. There is a myriad of other potential sources of stimuli in-store that can compete for attention. These include other shoppers who invariably (and annoyingly) always seem to complicate the environment; the task itself, which may require the identification of a particular category that will satisfy the underlying motivation; pre- and post-shopping activities that may be competing for attention; electronic devices, and finally retailer-placed stimuli for other categories that are unrelated to the particular task. Thus, visually, a retail store can be enormously complex and the number of stimuli cognitively taxing. ET technology has made it possible to see exactly what a customer is looking at, for how long, and in what sequence. The ability to analyze objective data about what customers look at in store has a consequence of changing the research agenda for academics studying retail and retail

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marketing because it provides some of the most objective measures that may be linked to cognitive processes.

The purpose of this paper is to review and synthesize ET studies related to retailing that have been conducted using ET technology in order to set a research agenda. We provide a summary of the findings of selected research published in major marketing, psychology, retail, and consumer behavior journals. We highlight key findings of benefit to retailers and academics and propose theoretical frames and topics for further study.

We begin with a background and highlight the significance of this review (Section 2) from the perspective of the retail industry and of the use of ET technology as a methodology. The methods by which we identified the studies are discussed in Section 3. The literature is synthesised to reveal a diversity of themes including retail display elements (signage, complexity), study environment (retail or laboratory), consumer involvement, category related expertise, familiarity, decision process, time pressure, and shopper motivation. The synthesis of the review is discussed in Section 4, which frames the paper with a discussion of the link between visual attention, cognition, and information processing. In this section, we also discuss attention to advertising because advertising can serve to prime the consumer prior to the shopping experience (Kwang et al., 2014; Mandel and Johnson, 2002; Otterbring et al., 2014). The three sections that follow report ET studies pertaining to the three categories of retail environments: Section 4.1 identifies pre-shop studies, Section 4.2 focuses on situational influences; Section 4.3 examines the retail shopping environment at the macro-level (store complexity and store environment); and Section 4.4 examines micro-elements in the retail environment including point-of-purchase, display complexity, and product selection. We then move to the identification of a research agenda and end with some limitations of the paper in Section 5.

## 2. Background of problem

In contrast to the usually assumed ‘rational’ consumer engaging in a comprehensive information search, research has demonstrated that typically very little information is required to make a purchase decision (Hansen, 1969; Olson and Jacoby, 1972). Brand recognition has been shown to influence purchase behavior (Hoyer and Brown, 1990), and the brand can be a salient cue that is an important driver in the decision to buy (Chandon and Wansink, 2002; Ehrenberg et al., 1997; Keller, 2013; Nedungadi, 1990), because brands save the shopper valuable cognitive energy and time. Other work supports the notion that the most used cues are brand and price (Dodds and Monroe, 1985; Jacoby et al., 1974; Kardes et al., 2004; Olson and Jacoby, 1972). Collectively, these findings suggest that very little information is processed prior to making a purchase decision, making visual cue selection at the point of purchase of critical interest from both the academic and practitioner perspectives.

Retailers control, combine and use elements of visual marketing (e.g., displays, advertising) to create a retail environment that is easily distinguished to capture consumer attention and assist purchase. Understanding which factors attract visual attention and how these are related to purchase intention or actual purchase will assist retailers in creating an optimal shopping environment. These factors may also have the indirect benefit to the consumer in making the shopping environment more pleasurable and the shopping process more efficient.

More portable and affordable ET devices have revolutionized the consumer research arena with their potential to produce objective evidence to support the link between visual contact, cognition, and product purchase. We reviewed relevant bodies of literature regarding the visual attention-cognition-purchase decision sequence and found few published studies related specifically to the retail environment.

### 2.1. Eye movement and tracking

Eye movement is the fastest movement the human body can make, with approximately 170,000 movements per day (Wedel and Pieters, 2008a) and an average resting time (or fixation) of only 200–500 ms (Rayner, 1998). Eye fixations interact with specialized areas in the brain to process information collected during these fixations. This interaction directs eye movement to stimuli areas that are salient to consumers, the result being purposeful and goal directed eye-movement (Wedel and Pieters, 2008b). That is, fixations do not occur at random, rather the type of information sought, and its relevance to the task at hand, guide eye movement.

ET was developed in the medical field, and rapidly found its way into the consumer research arena. The majority of the early peer-reviewed studies using ET technology investigated the process of reading by following eye-movements (see Rayner's, 1998 article for a 20-year review). In consumer research, peer-reviewed eye tracking studies are growing, but are still sparse (see Wedel and Pieters, 2008a for a comprehensive consumer research review). Linking visual data with consumer behavior theory, especially through cue utilization and information processing, could substantially advance our understanding of the shopping process and the cognitive processes that underpin it.

We found that much of the ET research was motivated by marketing academics seeking to test packages, brands, and advertising theories which may be characterized as study on a micro-level. As retail academics, we wanted to provide a synthesis of the findings for retailers and to note the contributions being made to theories of in-store retail marketing and their underlying practical implications by investigating eye movement at a more macro-level. Useful starting points are Purucker et al.'s (2013) overview of marketing papers using ET technology and Yang and Wang's (2015) review of 28 ET articles published in business journals.

### 2.2. Problems identified in assimilating ET study results

In seeking to understand the use of ET as an instrument to study consumer behavior in retail stores, we encountered two problems. First, there are presumably many proprietary ET studies not published in the public domain. For example, the annual National Retail Federation “Big Show” has featured the results of proprietary studies conducted by Fast Moving Consumer Goods (FMCG) companies in retail settings (Taylor, 2014), but with few details about study methods and findings. There is a lack of transparency about proprietary study findings, and this lack of transparency makes it difficult to assess which store environment cues and aspects of the shopping process have been investigated and thus impossible to place these findings into the current body of literature. Consequently, the lack of transparency hampers establishing an efficient research agenda.

Second, we considered the practical and managerial significance of the findings of the studies. While it is valuable to know and understand consumer focal cues when viewing shelves, displays and other POP (Point of Purchase) cues, the last piece of the puzzle is how that attention translates into product sales. We identified only five studies to date that linked research to actual purchase in the retail environment (Clement, 2007; Clement et al., 2013; Harwood and Jones, 2014; Otterbring et al., 2014; Russo and Leclerc, 1994), and all used packaged goods as stimuli.

These issues led us to further refine our search strategy to include some studies that were not focussed in-store, but dealt with matters such as visual complexity.

## 3. Methods

We began the search for articles by using key words “in-store,” “retail” and “eye tracking studies” on Business Source Complete, Proquest, PsychInfo, Expanded Academic ASAP, Science Citation Index,

**Table 1**  
Summary table of retail focused eye tracking studies.

Citation	Design/Product stimuli	Independent variables	Dependent variables	Purpose	Limitations
Russo and Leclerc (1994)	lab experiment applesauce peanut butter ketchup	eye fixations	decision-making stages	use eye fixations to delineate decision making stages	videotaped eye movement (not eye tracking)
Janizewski (1998)	lab experiment secondary data (apparel purchase) women's apparel	product size text price product	competition for attention purchase	identify search routine, eye fixations as predictors of sales	computer screen; captured corneal reflection to measure eye movement
Pieters and Warlop (1999)	lab experiment rice soup shampoo salad dressing	time pressure motivation fixation duration saccades (within and between brands)	information acquisition filtering brand choice	assess the effect of time pressure and motivation on visual attention and brand choice	no display signage or fixtures as stimuli
Clement (2007)	in-store field study pasta jam	scan path eye fixations shopping time pressure	decision-making stages	assess the impact of package design and visual attention on buying behavior and decision making stages	45 of 61 subjects excluded for poor data or technical problems, no definition about how purchase phases were delineated
Chandon et al. (2009)	lab experiment soap pain relievers	number of shelf facings level of shelf facings	visual attention visual re-examination recall brand consideration brand choice attention (fixation duration)	examine the influence of shelf facings, shelf position, and brand influence on visual attention and brand consideration/choice	identical packaging may reduce search time, conducted in a laboratory setting
Seva et al. (2011)	lab experiment junk food	package elements (color, text size, claim) shelf position number of facings	visual attention brand inferences brand choice likelihood	assess the effect of package design elements on visual attention	used 2 dimensional image, only tested low priced FMCG (identical packaging)
Atalay et al. (2012)	lab experiment meal replacement bars	horizontal centrality	visual attention brand inferences brand choice likelihood	analyze the effect of display orientation (vertical/horizontal) on visual attention	retail planogram shelf testing (not a choice task), fictitious brands, identical packages
Clement et al. (2013)	in-store field study lab experiment jam	package design features time pressure brand familiarity	visual attention visual search time	assess the effect of package design elements and time pressure on visual search	used FMCG, eye tracker mounted on bicycle helmet
Behe et al. (2013)	lab experiment flowering plants	display elements (information, price, etc.) product product involvement	visual attention purchase intention	analyze the influence of product involvement on visual attention and purchase intention	laboratory study with images of plants; small sample
Shi et al., (2013)	lab experiment personal computers	12 product attributes (e.g., memory, price) horizontal vs. vertical condition	information acquisition decision making process arousal	evaluate online decision making and attribute search	limited product (PC), not retail setting (website)
Serfas et al. (2014)	lab experiment picture of store apparel vs. grocery store interiors	utilitarian vs. hedonic contextbuying impulsiveness		measure pupil dilation and impulse-shopper arousal in hedonic and utilitarian contexts	used grayscale images (not color) did not ask if subjects liked/enjoyed shopping
Harwood and Jones (2014)	in-store field study	consumer purchase goals, store familiarity store layout signage promotional offers sales assistants	visual attention	use mobile eye tracking to assess influence of retail environment cues on visual attention	small sample, used frequency counts of fixations but not fixation durations
Clement et al. (2015)	lab experiment toilet cleaner detergent dish soap scouring agent mustard hazelnut spread salami spice cookies ham toppings	product shelf placement private vs. national brand	product choice fixation time	analyzed how point of purchase visual merchandising tactics influence visual attention and consumer choice	did not clarify how fixation time was measured nor how areas of interest were drawn, no statistical analysis discussed for Study 2
Huddleston et al. (2015)	in-store field study flowering plants	sign type (price vs. information) display cues (price, information, product)	visual attention purchase intention	examine the influence of display elements on visual attention and purchase intention	small sample, subjects prohibited from interacting (e.g. picking up, touching, etc.) products
Behe et al. (2015)	lab experiment flowering plants	product involvement price information sign product	visual attention product choice	examine the effect of product involvement on visual attention to display elements	lab (computer image) study with 3 flowering plants in different quadrants (choice study)
Deng et al. (2016)	lab experiment candy	time, time constrained vs. unconstrained,	number of items fixated upon,	compare horizontal vs. vertical displays on influence for processing fluency,	not using same product and packaging in horizontal and vertical

(continued on next page)

Table 1 (continued)

Citation	Design/Product stimuli	Independent variables	Dependent variables	Purpose	Limitations
		horizontal vs., vertical display	length of fixation, size of consideration set	perception of assortment variety and product choice	displays, constraining time in only one study.

Social Sciences Citation Index, and Academic One File. The results led to few meaningful papers (< 6) at the time of the search. We broadened the topic to include fast moving consumer goods that had key words such as “retail marketing.” The broadening of the search to include those search terms led to a database of 152 articles. After removing duplicates, non-English, and non-peer reviewed articles and identifying articles that contributed to the topic of ET in retail stores, we were left with 14 articles that used a retail context for the study methods. We summarized the papers according to the object of study, independent and dependent variables, findings, limitations, and areas for future research. The summaries were then used to evaluate and synthesize the accumulated knowledge on ET studies in retail. See Table 1 for a list of these ET studies.

#### 4. Results of the literature review

We organized the results into five categories: studies which helped characterize the attention-vision-cognition linkage, studies on pre-shopping influences including advertising, advertising recall, and arousal; studies at a macro-level which examined the store environment; and micro-level studies which pursued topics such as POP elements and package design.

##### 4.1. Pre-shopping influences

Pre-shopping influences refer to factors that affect consumer decisions about what to buy and where to shop, for example, advertising. Before summarizing the studies that concentrated on pre-shopping influences, we begin this section with an overview of attention processes.

###### 4.1.1. Attention

The retail environment is rich with visual stimuli including product and POP communication. Regardless of the finding that 70% of all buying decisions are made at the point of purchase (Ståhlberg and Maila, 2012), identifying the product and any necessary information to facilitate a purchase in a complex environment is crucial to the consumer quest. Visual attention to relevant stimuli must occur before any information is cognitively processed to arrive at a purchase decision (Lin and Chen, 2006) even if this is just locating the desired brand. This is a view also present in cue utilization theory where attention is cited as one of the first steps in the consumer decision process (Olson, 1972). Visual attraction and retention are assumed to be key precursors to cognition and decision making, but the peer-reviewed literature does not provide much evidence of this, so it would seem that the old advertising adage that what is “unseen goes unsold” has not been rigorously investigated.

Attention is the cognitive process of concentrating on one aspect of the flood of stimuli detected by our senses for further processing (potentially resulting in long-term memories) and ignoring the rest (Smith and Kosslyn, 2006). Attention also implies being aware of the stimuli in the conscious mind, and is driven by both top down and bottom up processes (Smith and Kosslyn, 2006; Wedel and Pieters, 2006). Bottom up processes occur when important information from the external world attracts our attention, while top down processes draw attention to information based on our (internal) knowledge, beliefs, expectations, and goals (Smith and Kosslyn, 2006). Attention drawn to a sudden loud noise, flashing lights, or an attractive person is the result of a bottom up process, while finding a friend’s face in a crowd is the result of a top

down process. Wedel and Pieters (2006) found that both top down and bottom up processes affect behavior. This finding has been broadly supported by research cited here, though the effects are not always consistent.

Attention plays two key roles. First, it filters out the bulk of the sensory stimuli that we are confronted with on an ongoing basis, reducing it to a level that can be processed for the purposes of meeting whatever goal or task is currently directing our activity (Smith and Kosslyn, 2006). Second, it is important in the formation of long-term memory.

The link between attention and consciousness is unclear, not the least due to the considerable ongoing debate as to the nature of consciousness itself. Nonetheless they are related, as “whenever we attend to a stimulus we are conscious of it” (Smith and Kosslyn, 2006). Smith and Kosslyn (2006) identified two forms of consciousness: awareness consciousness and introspective consciousness. The first is a low level state in which we are aware of stimuli and events in the environment, whereas introspective consciousness is the state in which we are aware of not only the stimuli, but also of the internal representations and processes (Smith and Kosslyn, 2006).

In the ET context, a fixation should not be equated with attention—it is a necessary but not sufficient condition. The measure (a fixation) and the cognitive process (attention) are often conflated in the marketing literature (e.g., Duchowski, 2002; Purucker et al., 2013), and it is typically assumed there are no intervening processes (or at least none that matter) between a fixation and a long-term memory effect (e.g., Wedel and Pieters, 2000). The problem is indirectly acknowledged when fixations are referred to as “visual attention”, often with a minimum time stated (Pieters and Wedel, 2004; Meißner and Decker, 2010), but this conflation of fixation with attention assumes higher order cognitive processes are occurring. It would be more useful to recognize a fixation as an “opportunity to attend” (or OTA, much like advertising’s “opportunity to see”). Such an approach may assist in explaining why objects that receive a great deal of visual attention are not well recalled even when prompted (e.g., Atalay et al., 2012). We think the OTA concept should be explored to at least develop a better understanding of when a fixation is attention, when it is not, and what might drive such correspondence. At the very least the issue should be acknowledged.

###### 4.1.2. Arousal

Arousal refers to the “degree to which the person feels excited, stimulated, alert or active in the situation” (Donovan and Rossiter, 1982, p. 38). By creating stimulating shopping environments, retailers hope to elicit a state of arousal in their customers because, when combined with a pleasant environment, arousal can motivate approach (Donovan and Rossiter, 1982) and purchase behaviors (Groppel-Klein, 2005). There is also an important question in understanding how an arousal state may influence the utilization of cues.

We found only one study that used ET to measure arousal in a shopping context. In their study of the interaction of buying impulsiveness and arousal, Serfas et al. (2014) used pupil dilation to measure arousal to assess response to pictures of hedonic and utilitarian retail scenes. They found that arousal was elicited in impulsive buyers for both hedonic and utilitarian shopping and that arousal was not dependent on making a purchase. That is the retail scene itself was enough to create arousal. Further, impulse buyers were aroused, regardless of the nature of the retail environment. This is an important finding

for researchers, as it provides a starting point for understanding that visual marketing in a store can elicit a physiological reaction that is independent of cognitive evaluation (e.g. forming a perception of quality). These findings are, however, preliminary, and study limitations include the use of images rather than an actual shopping environment as well as a failure to link physiological reaction and cognitive evaluation to behavior. Future studies examining arousal should extend the research context to in-store environments and include a purchase task.

#### 4.1.3. Advertising elements

Prior to in-store or online shopping, consumers are often exposed to advertising and the opportunity to attend to this information, potentially affecting memory, may influence in-store behavior. We identified several ET studies that focused on attention to advertising elements (e.g., pictures, text, and product attributes). As many retailers, especially grocery stores, rely heavily on print advertising, this has been the focus of research. In print advertising, pictorial elements captured more attention than other elements, while text size captured incremental attention: an increase in proportion of surface area devoted to print (advertising copy) led to an increase in gaze duration (Pieters and Wedel, 2004). This effect was stable across product involvement, product motivation, and brand familiarity (Pieters and Wedel, 2004). Attention to one ad element was positively associated to attention to other ad elements (Pieters and Wedel, 2004). In a conjoint analysis of coffee brewing advertisements, consumer information processing increased for important attributes; specifically, consumers more often searched for brand and price in an isolated fashion and fixated most often on important product attributes (Meißner and Decker, 2010). Goodrich's (2011) attention tracking (vs. eye tracking) study of online advertising stimuli and attention found that pictorial (vs. banner/verbal) ads received more “mouse-clicks.”

Consumer engagement (measured by longer gaze durations and increased re-fixations) with a fictitious brand logo discovered that a more dynamic logo resulted in higher visual attention (Cian et al., 2014). While it is difficult to generalize results from so few studies for print advertising, these findings suggest that brand and pictorial elements are best able to capture attention, and, not surprisingly, consumers allocated visual attention to important product attributes. Consumer characteristics (e.g., product involvement) did not affect attention to advertising elements, though importance of product attributes did.

#### 4.1.4. Recall of advertising elements

For an ad to be effective, it presumably must have some memory effects. Indeed, recall of an ad (or its elements) implies some level of cognitive processing (Semenik, 2002), and thus, by definition, attention. Several ET studies analyzed advertising recall. In assessing apparel catalogues, Janizewski (1998) found that information surrounding an item had an impact on attention and recall, with an increase in “non-focal” information resulting in reduced attention to the product. Wedel and Pieters (2000) compared the influence of brand, text, and pictorial elements of print ads on memory for brands and, as expected, found that the brand element delivered the most information for an accurate brand memory. Maughan et al. (2007) tested ad recall, recognition, and liking of virtual bus shelter advertisements, finding that more and longer fixations to an ad was correlated with higher liking of the ad, but they could not clarify the cause-effect relationship. While ET has uncovered some interesting relationships between ad elements and their effect on visual attention and recall, these studies are not indicative of what may occur during the shopping process. Furthermore, these ET studies have not linked recall to in-store purchase; that is, no studies have used ET to examine whether advertisements viewed and remembered by consumers prior to shopping influence their purchase decisions.

## 4.2. Situational influences

Situational influences (e.g., time pressure and shopping goals) on attention have been investigated in several ET studies. Findings present conflicting evidence of the influence of time pressure on visual attention. One brand choice study reported that high time pressure led to more information filtering and faster information gathering, with higher levels of visual attention being positively related to brand choice (Pieters and Warlop, 1999). Deng et al. (2016) found that time pressure influenced number of items fixated upon: in a time-constrained condition, more items were fixated on, but for a shorter period of time. A (rare) in-store shopper study found that under more time pressure, consumers spent more time looking at a jam display, but did not pay more attention to brand or label text features (Clement et al., 2013). However, a study of Danish shoppers found that time pressure did not influence attention to packaging (Clement, 2007). Does time pressure motivate a laser-like focus, with an ability to quickly filter extraneous information, or is its impact negligible? These limited findings warrant further investigation of time pressure to more conclusively determine its role and the circumstances under which it influences visual attention.

Wästlund et al. (2015) explored the relationship between decision heuristics, visual attention, and consumers' choice processes. In three in-store field experiments, they found that 1) consumers with previously defined shopping goals exhibited narrower search behavior than those without such goals, 2) when faced with a second task, consumers exhibited wider search behavior during that task, and 3) those with a non-specific initial task had narrower search behavior in the second task, perhaps evidence of (cognitive) resource depletion. Overall, and as anticipated, Wästlund et al. (2015) concluded that the presence of defined goals influenced visual attention, which in turn created susceptibility to in-store marketing stimuli.

The nature of the goal (or task) may also moderate attention to different stimuli or aspects of a scene, and there is some evidence in the ET literature that the task influences the scan path (Wästlund et al., 2015; and Pieters & Wedel 2007). Logically, when shoppers have a pre-defined shopping goal, they exhibit narrower search patterns when fulfilling that goal, while those with non-specific goals look more broadly. Thus, we could hypothesize that a specific search task should lead to attention being more focused on resolving that task and so reduce the relative influence of bottom up processes, while a browse task should correspondingly increase the importance of bottom up processes driving attention.

Top down processes such as product involvement positively influence attention to product, price, and product information (Behe et al., 2013, 2015). These studies reported that consumers' product involvement was positively correlated with the amount of visual attention given to display signage. However, it also took longer for highly involved consumers to first fixate on product information (Behe et al., 2015).

Collectively these findings imply that top down processes interact with situational influences to direct visual attention. Breadth or depth of attention is a factor of time pressure, task specificity, and product involvement.

## 4.3. Macro-level: the store environment

Only one study used ET to evaluate the store environment on a macro-level. Harwood and Jones (2014) used mobile ET on 16 department store shoppers, discovering that different product areas (home vs. apparel) elicited different patterns of visual attention. Overall, visual attention focused on products rather than signage; prominent items in a scene, as discerned by consumers, emerged as a dominant visual cue used to navigate the store. Vertical sight lines facilitated directional decision-making (i.e., way-finding) and promoted browsing activity, while horizontal sight lines inhibited browsing behavior (Harwood and

Jones, 2014). These findings imply that consumer goals (top down processes) and marketing factors (bottom up processes) both affect attention priorities. Harwood and Jones (2014) posit that consumer factors drive visual attention through relevance of the stimuli to the individual, while marketing factors (e.g., displays) drive task related and browsing behaviors. Of course marketing factors will only do so if they are the focus of attention. If they are not relevant to the individual's task, it is most likely they will be ignored, as they may only be attended to as a result of bottom up processes.

Way-finding is an important in-store shopping process. Customers unfamiliar with a store layout allocated more attention to in-store signage during the navigation stage of the search process, while those familiar with the store layout attended more to in-store signage during the decision making stage (Otterbring et al., 2014). Previous exposure to sign content influenced visual attention. When consumers are familiarized (primed) with a store sign, this familiarity guided visual attention, resulting in faster and more frequent fixations on products similar to the initial signage priming, but had no impact on product choice (Otterbring et al., 2014).

Studies that investigate the link between attention to bottom up elements (controlled by the retailer) and actual product/brand choice are needed to better understand macro-level way-finding. Then comparisons can be drawn between macro- and micro-level attention behavior. While horizontal sight lines inhibited browsing behavior (Harwood and Jones, 2014), when viewing a display up close, horizontal displays were easier for consumers to process (Deng et al., 2016). Perhaps these conflicting findings can be explained by task specificity; for example, way-finding could be classified as a general task, while product selection is a specific task. Task specificity may influence attention processes and perceptual fluency. Observing attentional foci at first in the macro- (way-finding) and then micro-level (e.g., sign information and attention to price) will help identify inconsistent findings and might yield more meaningful or contextual insights.

#### 4.4. Micro-level: displays and packages

How products are presented and their proximity on a shelf influences visual attention (Otterbring et al., 2014). Many ET investigations have focused on packaged goods, perhaps because these products are well suited for laboratory studies using flat images projected on a wall or computer screen and comprise a majority of fast moving consumer goods (FMCG).

##### 4.4.1. Point Of Purchase (POP) elements

POP elements include packaging and display and in-store signage. Researchers have used packaged goods (generally FMCG) as stimuli in retail focused ET studies. Clement (2007) selected pasta and jam to investigate how packaging influences visual attention and buying behavior. Not surprisingly, they found a correlation between number of packages noticed and time spent on that category. For packaged products, a higher number of shelf facings (Chandon et al., 2009) and shelf position in the top or center was positively related to visual attention (Chandon et al., 2009; Seva et al., 2011). Clement et al. (2013) ran in-store experiments that investigated visual attention to packaged merchandise (jam) and found that high, slim products attracted initial attention. They also found product category familiarity did not shorten visual search time but previous experience with the retail outlet did. This is an interesting finding that has ramifications for changes to store layout, and may be related variability in shelf layout (plan-o-grams) between stores off-setting category familiarity.

The stage a consumer is at in the search process influences visual attention to POP elements (Clement, 2007; Otterbring et al., 2014). A study of 16 Danish shoppers showed that length of a “first glance” at a product was similar for purchased and un-purchased brands, and that visual search included both focused and “mindless” search behaviors (Clement, 2007). Consumers allocated the greatest level of visual

attention when the product was in hand, while visual attention in the post-purchase phase was shorter than the pre-choice phases (Clement, 2007). They did not test the effect of category familiarity, only brand familiarity.

In summarizing studies that examine the relationship between POP and attention, the diversity of study foci makes it difficult to draw meaningful conclusions. Based on the work cited in this section, attention is related to package size and shape, shelf position and layout, stage in the consumer search process, and store familiarity. Consumer characteristics also influence attention to POP elements. Many of these studies, however were focused on the FMCG context, which in the spectrum of all retail stores have fairly low complexity in the shelf context. Future studies should broaden the product categories beyond FMCG.

##### 4.4.2. Displays and display elements

In a display, consumers tend to look at the center of a horizontal display, allocating more visual attention to it, with center placement improving choice likelihood. This finding was confirmed in two studies (Atalay et al., 2012; Deng et al., 2016). Consumers process horizontal displays more fluently than vertical displays (Deng et al., 2016). Time constraints affect how consumers view horizontal (vs. vertical) displays. Specifically, there are more, but shorter fixations when faced with a multi-choice task in a time-constrained situation (Deng et al., 2016).

Proximity of various FMCG brands to each other on a shelf influences attention, and depends on placement. An analysis of the effect of national brand (NB) vs. private brand (PB) placement next to and away from each other on a shelf showed that when NB are next to PB, the NB received more visual attention (Clement et al., 2015). PB signage moderated the effect when in close proximity to NBs, indeed they increased sales of PB. Finally, they found a positive relationship between visual attention and product choice (Clement et al., 2015).

Orth and Crouch (2014) used wine displays to examine shopping goal effects (either utilitarian or hedonic) on perceived attractiveness, and found that under a utilitarian shopping motivation, the easier a stimulus is to process (the higher the processing fluency), the more a customer perceives the target as attractive.

Individual display elements appeal to specific consumer segments. For example, Behe et al. (2014) used plant display cues (including signage and the product itself) to understand how consumers used these cues in forming purchase decisions. Results identified three consumer segments (plant, price, and production method orientation), with each segment allocating more visual attention to a preferred display cue. This finding signifies congruency between a consumer's cue relevance and visual attention.

In the display oriented ET studies, we find more investigations on top down influences than bottom up, though bottom up influences are much more prevalent in ET studies with packages and package design.

##### 4.4.3. Package design

Consumers seem to prefer simplicity in package design and allocate more attention to simpler designs (Clement et al., 2013; Orth and Crouch, 2014). Both studies used ET to study consumer response to high and low complexity in package design and how complexity influenced processing fluency. A design is perceived as more attractive and easier to (visually) process in a low complexity package display context, and further, increasing context complexity (i.e., the surrounding products/display) had a negative effect on attention. These results support Janizewski (1998), who found that visually demanding information displays decreased attention time allocated.

Not all products, however, are merchandised in packages or on shelves, and not all are reliant on the customer reading packaging information, thus it is important to include a variety of product stimuli in ET studies to ascertain the extent to which the acquisition of visual attention is similar (or different) across product categories. While the preponderance of ET studies focused on FMCG, several used minimally

packaged products such as apparel or plants as study stimuli. The apparel study found that information surrounding an item had an impact on attention and recall, with an increase in non-focal information resulting in reduced attention to the product (Janizewski, 1998), while the garden center studies identified a positive link between product involvement and visual attention to signage (Behe et al., 2013).

#### 4.5. Purchase and purchase intention

The holy grail outcome for measuring success of visual marketing is actual product choice or purchase. Prior to linking visual marketing to choice, we must first understand the consumer decision process as it is linked to visual attention. Several researchers have investigated the link between eye-movement and decision process stages. In one of the first ET studies that used a retail context, Russo and Leclerc (1994) pinpointed four stages in the consumer choice process by analyzing eye fixations: initial sequence, deliberate and effortful brand elaboration, final fixations, and post-announcement fixations. Similarly, Clement (2007), while not clearly defining the parameters of each phase, used eye scan paths to identify six in-store decision phases: pre-attention, succeeded attention, tipping point, physical action, semantic information processing, and post-purchase. Elaborating on decision processes, Shi et al. (2013) identified a “gaze cascade” in which a preferred alternative is used as the basis for comparing other alternatives. These research findings empirically linked gaze cascades with the preferred alternative, which became the basis for the visual comparison of other alternatives. While these studies arrived at different conclusions, they all acknowledged the presence of measurable attention stages using ET.

Several studies connected micro POP elements to purchase intention. A study using plant displays as stimuli investigated which display attributes influenced consumers' purchase intentions and found that visual attention to product information was the strongest motivator of purchase intention (Huddleston et al., 2015). Visual attention to products was positively related to purchase intention, and this relationship was strengthened by level of product involvement (Behe et al., 2013, 2015).

A positive relationship has been identified between visual attention and product choice (Behe et al., 2015; Clement et al., 2013). Consumers who make an actual product selection (as opposed to a virtual selection) spend more time looking at all aspects of a display (product, price, and information), with attention to an information sign demonstrating the most significant relationship to choice (Behe et al., 2015).

While some studies have used ET to better understand purchase intention (as a proxy) and actual product choice, linking visual attention to purchase has not been an area of particular focus even though product choice is the ultimate goal of marketing. Finding correlations between signage and choice are encouraging but it remains an area with great scope for better understanding the direction of the relationship between visual attention and product choice.

#### 5. Gaps which lead to a research agenda/limitations of previous studies

In conducting this review, we have observed a number of areas that are ripe for further investigation, some of which focus more particularly on more complex retail environments, and others which are more widely applicable to ET generally.

We observed that the majority of studies using ET technology were conducted in laboratories using mock-ups of shelf displays (e.g., Atalay et al., 2012; Chandon et al., 2009; Serfas et al., 2014), with only a few analyzing attention to actual retail displays (Behe et al., 2013, 2015), perhaps due to limitations of technology and analytical capacity. While the laboratory environment has resulted in significant progress in understanding visual information capture and subsequent behaviors, it is not particularly representative of the actual retail environment, nor can it adequately reproduce the situational factors and stressors affecting

shoppers. This is especially the case when retail moves away from the flat-racked fast-moving consumer goods environment to more three-dimensional displays and interactive spaces in more complex retail environments.

Firstly, we call for additional work in exploring the attention-cognition-choice linkages. Cognitive psychology and related disciplines may facilitate our understanding of visual cue selection and information processing prior to purchase or choice. Using a variety of theoretical approaches to understand the attention-cognition-choice linkages is needed to increase the explanatory power of study findings. Cue utilization theory (Olson, 1972) helps to understand cue relevance and sequence of observation. Product involvement (Petty and Cacioppo, 1986) has demonstrated explanatory power in several studies (Behe et al., 2013, 2015; Huddleston et al., 2015) and should be further investigated; investigating product involvement in light of motivation to process information (e.g., MacInnis et al., 1991; Park and Mittal, 1985) may be a fruitful theoretical combination. If we understand the extent to which consumers who are involved with a product category are motivated to process information, that understanding will provide guidance as to the depth and detail of information to provide. For example, a highly-involved consumer with a high motivation to process information might take the time to watch a video that demonstrates various product uses.

Furthermore, research shows that consumers decide relatively quickly, with the time to product choice averaging 3–5 s (Behe et al., 2013, 2015), a finding more consistent with the satisficing, cognitive miser perspective rather than the rational consumer. The speed of decision and the rapidity of the attention-cognition-choice linkage suggest that decision making may not be as strictly rational as first thought. Two theoretical frames can be applied to increase our knowledge of the degree to which consumers' visual attention leads to satisficing. Heuristics (mental shortcuts) assist in reducing task complexity by assessing probabilities and predicting values (Tversky and Kahneman, 1974). Investigating the degree to which heuristics influence visual attention and choice could provide evidence of satisficing strategies. Scanpath theory (Noton and Stark, 1971) posits that individuals exhibit an order and pattern of fixations (scanpath) when viewing a stimulus, and that scanpath remains relatively consistent in subsequent viewings of the same object. Gaining an understanding of the scanpath(s) used to make a product choice would inform retailers of efficient and effective ways to organize POP displays. ET studies in retail settings have yet to investigate the sequence of consumer scan paths, thus providing a topic for future investigation. Interesting research questions to address would be 1) to what degree are consumer scan paths similar for the same stimuli, 2) do heuristics influence scan paths, and 3) do scan paths and heuristics interact to influence product choice?

Secondly, researchers should consider the role that priming may play in attention and choice. We did not find any studies that included priming in online or print advertisement (pre-shopping) and only one study with in-store context used priming to investigate attention (Otterbring et al., 2014). Similarly it is also possible that prior usage may affect scan paths. To expand our understanding of those pre-shopping influences on attention, the role of priming in motivating visual attention is needed. How does advertising recall play out in the store, and what influence does it have on attention and the shopping process? In-store distractions (e.g., text messages, retailer pushed digital communications) may further confound the shopping experience by shifting attention away from the task at hand. Time pressures may also fit here as these are pre-shopping conditions to influence attention.

Finally, the richest area for investigation appears to be at the macro-level. We think there are several areas ripe for further investigation, beginning with consideration of how preceding and following activities (the activity stream) affect visual attention and decision-making. Shopping of any kind occurs within a context (or activity streams) that varies between individuals but also for the same individual depending on when the shopping trip occurs. For example, it might be a shopping



trip between leaving work and arriving home in order to make dinner for that evening. It might be a shopping task that occurs on a Saturday morning in between dropping the children at a sports practice, picking them up, and then going to a relative's for lunch. The variety of the activity streams within which shopping occurs has ramifications for what happens within store when making choices that may not be captured in experimental situations, if only due to the differing stresses (nature and level) they may engender in the shopper. Shiv and Fedorikhin (1999) found that when greater stress is imposed on shoppers, choice became more dependent on heuristics and emotional decision-making. It may also have an impact due to more cognitive resources being directed to the surrounding activities rather than the shopping expedition, thus affecting choice by restricting memory rehearsal and retrieval, ultimately affecting what is noticed on the shelf or selling floor. Analysis of the activity stream and accompanying stress is an area that has received very little if any consideration in the literature and, given its potential impact and ramifications for shopping, is an important area for future research.

Environmental psychology could provide a theoretical frame to trace consumer attention at the macro level. The stimulus-organism-response (SOR) paradigm (Mehrabian and Russell, 1974) provides one such investigative lens. The retail environment serves as the stimulus and organism refers to the way that consumers translate the stimuli into meaningful information that helps decision-making. Response refers to an outcome or consumer reaction, which can be physiological, psychological, or behavioral (Bagozzi, 1986). Framing the consumer attention journey in light of the SOR paradigm could provide a starting point to pinpoint similarities or differences in attention processes across a variety of retail shopping contexts. Additionally, research may investigate the mediating and/or moderating role of top down factors interacting with the bottom up stimuli.

More investigations are needed to understand the role of store complexity and store environment in getting a potential consumer to the right product display in order to make a choice. In other words, to what degree does store and display complexity affect the path to purchase? There are many questions that remain unanswered. What is the role of interaction between employees and consumers, particularly with respect to the direction of attention? Do employees serve as a distraction or do they assist in focusing consumer attention to a product?

Consumers may be multi-tasking and multi-screening in store, which may distract attention (or inhibit purchase if comparison shopping). Sight lines and directional signs, and the related issue of sensory cues (e.g., music, scent, etc.) and their congruency in way-finding to the category may either facilitate or impede attention, but we don't yet know how. Navigating to the checkout (and perhaps exit) and the experience at the cash register, and indeed the number of registers and persons in line, may influence the purchase process. Navigating the plethora of stimuli within store may not be simple and may contribute to consumer confusion and thus post-purchase regret. Ultimately of particular interest are the effects any and all of these in-store complexities may have on the allocation of attention and ultimately purchase decisions.

To date research activity has largely focused on single categories, and has not considered the impact of the larger shopping context. Not only does shopping occur within a stream of activities, but within the shopping trip itself purchases occur within a stream of choices that result in the basket of goods purchased.

The area that represents the greatest recent interest to researchers is related to the micro-level elements (e.g., package, price, sign information). POP elements appear to be the most studied and do contribute to our understanding of attention and product selection at a very small scale. Moving a step back, the display level may still be ripe for study, particularly in terms of understanding how display complexity affect attention and choice.

Lastly, but most importantly to the retailer, is exploring what facilitates the "buy here" for the store and the "buy ours" for the

manufacturer. What motivates visits must occur before what motivates choice. While the aforementioned agenda provide pieces of the puzzle for each, those questions remain rich areas of inquiry.

### 5.1. Limitations

One of the major limitations of our study is the dearth of eye-tracking studies and the fact that these studies use different methodologies, thus leading to non-convergent results, making a seamless synthesis impossible. Despite the lack of common methods employed in the existing body of literature, we believe that our review will assist future researchers.

By its nature research often occurs in artificial settings. The task of the researcher is to mimic the desired environment as much as is practicable given the limitations of equipment, theory, and research questions. ET research in marketing, particularly when considering product choice, is no different. Due to limitations of equipment, processing capability, or funding, research in this area has tended to use relatively artificial environments. Specifically, there are a limited number of studies undertaken with in-store settings. The majority of reviewed studies were conducted in laboratories with the subject viewing computer images of products. These simulations are rectangular, planar, and regular, rather than three dimensional and changeable, as consumers would experience during shopping. This is mostly in the form of fixed image displays that effectively immobilize the respondent (such as in Atalay et al., 2012; Pieters and Wedel, 2004; Purucker et al., 2013) and limit external validity.

The majority of studies investigated micro-level cues (e.g., logo and price) but virtually ignored macro-level aspects such as way-finding. We hoped to identify studies that investigated the broader aspects of store visual factors, but found few studies that did so. Similarly, the task respondents are given also influences behavior (Pieters & Wedel, 2007). The top down cognitive processes drive attention (Smith and Kosslyn, 2006) hence the task at hand of which there may well be several-determine what is attended to in the shopping environment. This is not well accounted for in laboratory settings or situations that do not more closely mimic an actual shopping situation.

Finally, there may be additional publications regarding ET in a retail setting that our search terms did not identify or that appeared in journals not well linked to the electronic databases searched. Furthermore, we strived to include some of the more relevant theory that may, with ET data, inform development of future studies and provide greater insight to consumer decision-making and purchase. Despite the aforementioned limitations, this review should be considered a starting point in developing a research agenda using ET to trace the path to purchase and to understand the link between visual attention and product purchase.

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