DEPARTEMENT TOEGEPASTE ECONOMISCHE WETENSCHAPPEN

ONDERZOEKSRAPPORT NR 9724

VISUAL ATTENTION DURING BRAND CHOICE: AN EYE-FIXATION ANALYSIS

by

Rik PIETERS

Luk WARLOP

Katholieke Universiteit Leuven

Naamsestraat 69, B-3000 Leuven

ONDERZOEKSRAPPORT NR 9724

VISUAL ATTENTION DURING BRAND CHOICE: AN EYE-FIXATION ANALYSIS

by

Rik PIETERS
Luk WARLOP

D/1997/2376/26

VISUAL ATTENTION DURING BRAND CHOICE:
An Eye-Fixation Analysis

July 1997

Rik Pieters
Katholieke Universiteit Brabant (Tilburg)

Luk Warlop
Katholieke Universiteit Leuven

VISUAL ATTENTION DURING BRAND CHOICE:
The Impact of Time Pressure and Task Motivation

Abstract

Measures derived from eye-movement data reveal that during brand choice consumers adapt to time pressure by accelerating information acquisition, by filtering information and by changing their information acquisition strategy. In addition, consumers with high task motivation filter brand information less and pictorial information more. Consumers under time pressure filter textual ingredient information more, and pictorial information less. The results of a multi-level logistic regression analysis reveal that the chosen brand is involved in significantly more intra-brand and inter-brand saccades than non-chosen brands, independent of time pressure and task motivation conditions. Implications for the theory of consumer attention and for pretesting of packaging and shelf lay-outs are offered.

INTRODUCTION

If the poet is right that the eyes are the mirror of the soul, consumers' eye-movements should be informative about processes such as attention, information acquisition and brand choice. It may come as a surprise that despite the long history (Karslake 1940) and obvious potential of eye-tracking (Kroeber-Riel 1993). applications to relevant marketing questions are scarce (see Janiszewski 1995; Russo 1978; Russo and LeClerc 1994; Van Raaij 1977) and contributions to theory development and testing have been limited.

In their review of consumer decision making, Payne, Bettman and Johnson (1993) call for the development and refinement of process-tracing methodologies that allow consumers highly flexible and rapid access to information, and in a recent review Bagozzi (1991) calls for the use of psycho-physiological measures to test hypotheses about underlying information processing and choice processes, grounded in sound theory. We follow up on both calls by examining consumer's visual attention during brand choice, as it is influenced by two relevant context factors. We use eye-tracking methodology, and develop eye-movement measures which build on theories of consumer attention and choice.

Time pressure, an environmental condition, and task motivation, a consumer individual difference variable, have been shown to systematically affect decision making and choice processes (Payne, Bettman and Johnson 1993), but they have not been examined jointly. In addition, both have been studied traditionally with information display boards, verbal protocols and similar methodology, but not with eye-tracking techniques. Eye tracking is particularly valuable in visual attention and choice research because the processes under study may occur very rapidly (Payne, Bettman and Johnson 1993), are largely automatic (Grunert 1996), and difficult to verbalise (Ericsson and Simon 1984). This study examines the influence of time pressure and task motivation on visual attention during brand choice using eye-tracking methodology.

Marketing practitioners and academics share the belief that consumer attention and in-store brand choice are intimately related (Cox 1970; Dreze, Hoch and Park 1993; Kotzan and Evanson 1969; Wilkinson, Mason and Paksoy 1982). Manufacturers try to differentiate themselves from the competition through vivid packaging design, to make their brands more noticeable. Retailers manage shelf space and special displays to draw attention to products and brands they prefer to sell (Allenby and Ginter 1995). Such attempts rest on the assumption that visual attention is a precondition to subsequent processes that eventually lead to choice, and that increased visual attention will increase the likelihood of choice. Despite the common assumption of a significant association, marketing research on the attention-choice relationship is scarce. This study examines the relationship between visual attention and brand choice, and the impact of time pressure and task motivation on the stability of the relationship.

The study aims to make three contributions. First, it offers insight into the nature of the adaptation of consumers' visual attention to time pressure and task motivation, which have not been considered simultaneously in previous research. Second, it documents the nature of the often assumed but rarely examined relationship between visual attention and brand choice. Third, it examines indicators derived from eye-movement data that are intimately linked to the theoretical constructs under study, and that have not been applied in previous marketing research.

Before we present formal hypotheses and the specifics of the study's design and procedures, we will review briefly the relevant prior research on which we build. First we will introduce visual attention as an important component of the brand choice process. Then we discuss the impact of time pressure and task motivation on visual attention, and the attention-choice relationship.

VISUAL ATTENTION

Visual attention is conceptualised as ... a brain operation producing a localised priority in information processing - an attentional 'window' or 'spotlight' that locally improves the speed and reduces the threshold for processing events (Deubel and Schneider 1993, p.575). Visual attention manifests itself as observed motor movements of the eye and head, which ensure that the 'spotlight' of attention illuminates the desired region in space.

The spotlight of visual attention follows a scan-path over the stimulus, consisting of fixations and saccades, and several smaller corrective eye-movements. Saccades are quick jumps from location to location during which vision is essentially suppressed (Sperling and Weichselgartner 1995). Fixations are the pauses between saccades during which the eye is relatively immobile. Since information acquisition occurs during fixations, they have been called the basic unit of encoding (Loftus 1972). Analyses of eye-movement data are based on the location and duration of fixations, and on the pattern of saccades (Viviani 1990).

Since visual attention is selective, consumers will not fixate all locations of a stimulus display in the same way. Some locations of the display will be fixated more densely than others, and some locations may be skipped entirely. Research shows that informative regions of stimuli are more likely to receive fixations than other regions (Loftus 1972).

Information acquisition during fixations appears to be a two-stage process (Loftus 1983; Christianson, Loftus, Hoffman and Loftus 1991; Viviani 1990). In the first or perceptual stage, the visual system acquires information from the physical stimulus. This stage affords an abstracted representation of the stimulus, and its duration is assumed to be relatively stimulus and person-independent and fixed. In the second or conceptual stage, cognitive processes come into play. This stage affords an identification of the stimulus by comparing the representation with pre-existing knowledge in memory, and its duration is assumed to be variable. As a consequence, the overall duration of fixations is variable as well. Research reports fixation durations ranging from 50 milliseconds to over a second, depending on task and subject characteristics (Gould 1976; Loftus 1972; Loftus and Mackworth 1978; Viviani 1990) with an average between about 200 and 400 milliseconds (e.g., Christianson, Loftus, Hoffman and Loftus 1991; Leven 1991).

Saccades provide information about the pattern of visual attention, and they have been used to study reading, picture perception and visual search processes (Rayner 1994). Before beginning to scan a stimulus, and as a function of the task and the expected properties of the stimulus, individuals prepare a global scan routine (Levy-Schoen 1981). For instance, individuals prepare to make multiple horizontal saccades prior to a reading task (Rayner 1994). During the scanning routine, physical characteristics of the stimulus and the information content, and other local factors may give rise to adjustments of the global scan routine (Janiszewski 1995).

TIME PRESSURE AND TASK MOTIVATION

Many important decisions have to be made under time pressure, with insufficient time to collect complete information, and to weigh all pros and cons extensively (Svenson and Maule 1993). Time pressure regulates the amount of information that can be processed, and its impact on consumer decision making appears significant (Iyer 1989; Payne, Bettman and Johnson 1988; Wright 1974; Wright and Weitz 1977). Since research about the impact of time pressure on visual attention has been lacking, we will briefly review findings from decision and their implications for visual attention. The conceptual model of this study is presented in Figure 1.

**********Insert Figure 1 about here**********

Consumers appear to use at least three strategies to cope with time pressure: by accelerating information acquisition, by filtering part of the available information, and or by a shift in the information acquisition strategy.

Acceleration occurs when consumers speed up information collection and processing (Ben-Zur and Breznitz 1981). When accelerating, the consumer does everything as usual, only faster. One way to accelerate the rate of visual information acquisition during brand choice under time pressure is by reducing fixation durations. This is accomplished by reducing the time spent encoding the stimulus in the second, conceptual stage of information acquisition. In a relevant study, Levy-Schoen (1981) found that the average fixation duration of individuals who read a text slowly was 287 milliseconds, as compared to an average fixation duration of 247 milliseconds for individuals who read at their normal pace. The reverse effect of speeding up reading was not examined, but appears likely.

Filtration occurs when consumers become more selective in the face of time constraints, and ignore some information in favour of other, purportedly more relevant, information (e.g., Easterbrook 1959). Filtration in visual attention is demonstrated when consumers skip certain elements of information about the brands in the display, or do not fixate some brands at all. The decision to skip elements is based on global expectations about the types of information in different locations of the display, and on parafoveal and peripheral attention during scanning (Janiszewski 1995).

Finally, a strategy shift occurs when consumers adopt modes of information acquisition and decision making which are less costly and faster to implement than others. Research indicates that under time pressure, consumers use simpler, non-compensatory rules more frequently than compensatory rules (Svenson, Edland and Slovic 1990; Edland 1994), and that they weigh negative information more heavily (Wright 1974; Wright and Weitz 1977). Investigating choices among gambles, Payne, Bettman and Johnson (1988) found that under time pressure their subjects shifted from a processing-by-brand to a processing-by-attribute strategy. Processing-by-attribute increases the likelihood that all alternatives are scanned at least partially within the time available for task completion, and it is cognitive less taxing (Bettman, Johnson and Payne 1991). Visual attention patterns provide insight into processing and acquisition strategies, since saccades within brands (intra-brand saccades) express information acquisition by brand, and saccades between brands (inter-brand saccades) express information acquisition by attribute.

The effects of task motivation on cognitive elaboration during advertising processing have been examined extensively (cf. Petty Cacioppo and Schuman 1982) and some research has examined task motivation effects on attention for advertising (cf. Celsi and Olson 1988). This research indicates that under high task motivation, consumers spend more time acquiring information, scrutinise the message arguments more extensively, and tend to base their overall evaluation more on message arguments than on peripheral cues (Petty and Cacioppo 1986). Some research indicates that under high task motivation, consumers use more compensatory processing (Irwin and Smith 1957). This suggests that the impact of task motivation on visual attention during brand choice may be complimentary to the impact of time pressure. Specifically, we expect consumers under high task motivation to decelerate information acquisition, as evidenced by longer fixation durations. We also expect them to attend to more elements of the stimulus, as evidenced by a lower frequency of skipping, and we expect them to use more information acquisition by brand, as evidenced by higher numbers of inter-brand saccades. Of course, the extent to which time pressure and task motivation are complimentary depends on the strength of the experimental manipulations and the size of the effects. The following hypotheses are offered:

Hypothesis 1: Time pressure leads to acceleration, more filtration, and to more information acquisition by attribute and less by brand, as expressed through respectively decreased fixation durations, increased skipping of brand elements, increased inter-brand saccades, and decreased intra-brand saccades.

Hypothesis 2: Task motivation leads to deceleration, less filtration, and to less information acquisition by attribute and more by brand, as expressed through respectively increased fixation durations, decreased skipping of brand elements, decreased inter-brand saccades, and increased intra-brand saccades.

VISUAL ATTENTION AND BRAND CHOICE

The previous analysis suggests that fixation duration, frequency of skipping elements, and intra-brand and inter-brand saccades are relevant indicators of visual attention under time pressure and task motivation. The issue is whether the final choice of a brand from a set can be predicted from these indicators of visual attention. Recently, Russo and LeClerc (1994) examined consumers' visual attention during brand choice. While consumers made brand choices in front of simulated supermarket shelves, their faces were videotaped through a one-way mirror. Inter-brand saccades were determined from the videotapes by two judges. The results showed that the number of inter-brand saccades which included the chosen brand was significantly above chance levels, because a single brand emerged as the superior one in pairwise brand comparisons.

Methodological restrictions prevented Russo and LeClerc (1994) from analysing intra-brand saccades, but their results and those of others (cf. Russo 1978; Van Raaij 1977) make it likely that the chosen brand also receives more intra-brand saccades than non-chosen brands. Choice from a set of brands is frequently a multi-strategy process, in which consumers engage in processing-by-attribute to reduce the choice set to a manageable set, and in which they engage in processing-by-brand to make a balanced final choice, using various decision heuristics (e.g., Roberts and Nedungadi 1995). In such multi-strategy choice processes, the chosen brand will be engaged in more processing-by-brand than non-chosen brands, which results in a higher number of intra-brand saccades. In a similar vein, it is likely that compared to non-chosen brands, the chosen brand will be scanned more completely. Exclusion of brands from the set based on processing-by-attribute in early stages will frequently be based on partial information about the brand only (Payne, Bettman and Johnson 1993). This suggests that compared to non-chosen brands, less information elements of the chosen brand will be skipped. Predictions with respect to the relationship between fixation duration and choice are more difficult to make [1]. Some research indicates that both children and adults have the tendency to gaze longer at attractive as compared to unattractive faces, and that both prefer attractive faces (cf. Dion 1977; Langlois, Roggeman, Casey, Ritter, Rieser-Danner and Jenkins 1987). Yet, research has not examined whether the longer gaze to attractive faces is due to longer fixation durations or to increased fixation frequency, and research on fixation duration and brand choice is absent. Therefore, we will explore the relationship between fixation duration and choice, while conducting a test of the following directional hypothesis:

Hypothesis 3: Intra-brand and inter-brand saccades are positively related, and skipping of brand elements is negatively related to brand choice.

Hypotheses 1 and 2 predict effects of time pressure and task motivation on measures of visual attention for the whole set of brands from which consumers make a choice. Hypotheses 1 and 2 are supported when mean scores of the brand set as a whole on measures of visual attention differ between experimental conditions. Hypothesis 3 predicts a relationship between measures of visual attention and choice of a single brand from the set. The three hypotheses are reflected in the conceptual model in Figure 1. The question is whether the strength of the relationship between visual attention and choice is affected by time pressure and task motivation. If the attention-choice relationship is homogenous across experimental conditions, differences between the chosen and non-chosen brands with respect to visual attention patterns are stable across levels of time pressure and task motivation. Some research indicates that the relationship between visual attention and higher order cognitive processes is homogenous across a range of conditions. For instance, Russo and LeClerc 's (1994) results indicate that the relationship between inter-brand saccades and choice was stable across individual difference variables such as product category purchase frequency. Also, across multiple stimuli and conditions the relationship between fixation frequency and memory appears stable (Loftus 1972; 1983). The following hypothesis is offered:

Hypothesis 4: The relationship between measures of visual attention and choice is stable across time pressure and task motivation conditions.

Support for hypothesis 4 implies that while visual attention to the brand set as a whole adapts to relevant conditions, the relationship between visual attention and choice for a specific brand from the set is stable across such conditions. This would mean that the eye is not just the mirror of the soul, but that the mirror provides a robust image.

METHOD

Subjects. Fifty-two female and twelve male subjects ranging in age from twenty to forty-nine years were invited to participate in the study by a marketing research company. A study session lasted approximately 30 minutes and subjects were paid the equivalent of 15 US$ for their participation. Due to incomplete eye-recordings and insufficient calibration, the data of 10 subjects had to be dropped from the database. All subsequent analyses are based on the 54 subjects for which complete eye-movement data are available.

Design and Stimuli. The stimuli were four colour slides each showing a choice set consisting of packages of six brands in four product categories: rice, shampoo, canned soup, and salad dressing. All brands were unknown to the subjects. All four choice sets were depicted similarly to the way choice sets are typically located on store shelves. Three of the four sets were displayed as two rows of three brands. The salad dressing bottles, due to their height, were displayed as one row of six brands. All packages were clearly visible, and large enough such that all verbal information on the packages was clearly readable. The target slide was the one with the shampoo bottles.

The experiment was run as a 2 x 2 (Time Pressure x Task Motivation) between-subjects design. In the low time pressure condition, each slide was presented for a maximum duration of 20 seconds. A pilot study had shown that this was sufficient to inspect all brands on a slide in detail. The instructions in the low time pressure condition emphasised that subjects would have enough time to inspect the slide at their own pace. In the high time pressure condition, each slide was presented for a maximum of 7 seconds. The instructions mentioned that the subjects would not have much time to inspect the slides.

Task motivation was manipulated in two ways. Prior to presentation of the first slide, subjects in the high task motivation condition read that the purpose of the study was to test a number of brands that were about to be introduced on the local market, and that their evaluation of the brands was valued highly. Analogous to the procedure used by Petty, Cacciopo, and Schuman (1983) subjects were told that as a reward for their participation they could choose among a number of brands of shampoo. Subjects in the low task motivation condition were told that the study was part of the development of a test for new products. Low motivation subjects were not promised an extrinsic reward. Final number of subjects per cell of the design are 11 in low time pressure-low task motivation, 12 in low time pressure-high task motivation, 15 in high time pressure-low task motivation, and 16 in high time pressure-high task motivation.

Data Collection Procedure. Subjects participated individually in the study. Upon entering the experimental room, they read a booklet containing the instructions. They were informed that a camera would record their eye movements while they were exposed to a number of brands from various product categories. An explanation of the study's objectives followed, including the manipulation of task motivation. Then the subjects were seated in front of the screen on which the stimulus slides would be projected from behind. The center of the screen, which measured 70 x 70 cm., was located at the consumer's eye height. The distance between the eyes and the screen was 120 cm. Consumers were instructed to place their head on a small head rest. Eye movements were recorded by an infrared camera located below the projection screen. The camera was calibrated on the subject's right eye. During measurement, the position of the fovea was recorded fifty times per second, by infrared corneal reflection, which allows linear eye-movement recordings up to approximately 10-15 degrees of visual angle from central fixation, and provides accurate measurement down to movements of 0.25-0.50 degree in amplitude (e.g., Young and Sheena 1975).

The slides with the stimuli were projected on the screen intermittently from two Kodak Ektapro 9000 slide projectors, with Doktor PC lenses, and fast shutters. The onset of each slide was announced through small loudspeakers located left and right from the subject's head. The target slide (shampoo) was always in second position. After each slide with brands, subjects saw a slide with six boxes, labeled A through F, whose locations corresponded to those of the brands in the set seen previously. They were asked to indicate their choice for a brand by naming the letter of the box that corresponded to the chosen brand. Subjects pressed a continue button when they were done, in order to see the next slide. By providing subjects with this opportunity, we could examine whether exposure duration in the condition with low time pressure was not too long. Slide projectors, auditory instructions, recording of brand choices, and the infra-red eye recording were computer controlled.

After making their final choice, subjects received a questionnaire. First, memory for the brands and products on the slides was assessed. Second, subjects answered manipulation check questions. Next, they saw the slide with the six shampoo brands again, and were asked to indicate their most preferred brand. In all cases, the most preferred brand corresponded to the brand chosen earlier.

In the memory task, subjects were asked to recall everything they could remember of the products and brands on the four brand displays they had been exposed to (product and brand names, form, colour and textual elements. The total number of elements recalled from the shampoo slide constituted the measure of memory.

Manipulation checks included items about experienced time pressure and task motivation, including five items from Kapferer and Laurent's (1985) and Jain and Srinivasan's (1990) involvement scales. The experienced time pressure item read "To thoroughly inspect the slide with the six products, I had ..." with a 7-point response scale from "much too little time" (-3) to "much too much time" (+3). If time pressure affects subjects' arousal in addition to their processing capacity, potential differences between time pressure conditions can not be unequivocally attributed to capacity limitations (Pham 1996). Three items in the questionnaire assessed consumers arousal during the task. The items read "During the study I was ..." with a 7-point response scale from "very nervous" (-3) to "not nervous at all" (+3), "For some reason I do not feel very much at ease at the moment" with a 7-point response scale from "completely disagree" (-3) to "completely agree" (+3), and "Participating in this study was ..." with a 7-point response scale from "not at all exciting" (-3) to "very exciting" (+3).

The items to measure task motivation were formulated as follows: "When chosing a brand of shampoo, it is not a big deal if you make a mistake", "choosing the wrong shampoo is annoying", "if the shampoo that I have bought turns out to be the wrong one, I would feel bad about it", "choosing shampoo is difficult", "I'm completely uninterested in shampoo". All items were accompanied by 7-point response scales ranging from "completely disagree" (-3) to "completely agree" (+3). A task motivation measure was constructed by averaging across the five items (coefficient alpha .681).

At the end of the questionnaire subjects were asked to describe in their own words what they thought the purpose of the study was. None of the subjects guessed the true purpose, nor showed any insight in the task motivation manipulation.

<u>Measures of Visual Attention</u>. In their disaggregate form, eye-movement data are x and y coordinates of the center of attention (fovea) on the display, measured 50 times per second. This results in large amounts of data. For instance, in the low time pressure condition, 20 seconds of eye-movement recording results in 2000 data points per subject (20 seconds * 50 measurements * 2 coordinates). It is desirable to aggregate eye-movement data prior to statistical analyses. In the present study, x and y coordinates are aggregated to meaningful areas of the brand display, and eye-

movements are aggregated to saccades between and within these meaningful areas, as will be explained.

We define as relevant areas in the display all brands as a whole, as well as the three major elements within each brand's package, i.e., brand name, ingredient information, and pictorial. As shown in Figure 2 each shampoo bottle is defined as a separate major area of the display (areas A through F). Within each of these major areas three sub-areas are defined, each corresponding to a salient element of the package: the brand name (areas I, L, M, Q, T, and V) , the pictorial (areas G, K, N, R, S, and X), and ingredient information (areas H, J, O, P, U, and W).

**********Insert Figure 2 about here**********

Consistent with information display board research and with recently published eye movement research (Russo and Leclerc 1994), we focus on fixation durations and on the saccades or jumps from one meaningful area of the brand display to another to calculate measures of visual attention to brands. A saccade is bounded by two fixations on the same or different areas of the brand display. We define intra-brand saccades as all jumps from one area of a particular brand to another area of the same brand, and we define inter-brand saccades as all jumps from an area of a particular brand to an area of another brand. Average fixation duration is defined as the mean of all individual fixation durations on a particular area of the brand. Finally, areas of brands that receive no fixations at all are considered to be skipped. Figure 3 shows a hypothetical visual attention pattern to illustrate the data aggregation approach.

********** Insert Figure 3 about here**********

In this hypothetical visual attention pattern, there are four intra-brand saccades, two in brand A (G-H and H-I) and two in brand B (K-J and J-K). There are two inter-brand saccades, one from A to B (specifically I-K) and one from B to C (specifically K-M). The average fixation duration on brand A is mean of the durations of the fixations on areas G, H, and I. The average fixation duration on brand B is the mean of the durations of the fixations on areas K, J, and again K. As there is only one fixation on an area of brand C, its average fixation duration is the duration of the fixation on M. In total three areas are skipped, one in brand B (area L) and two in brand C (areas N and O).

RESULTS

Manipulation Checks. Subjects could press a continue button to view the next brand display. Subjects in the low time pressure condition pressed the continue button after 18.82 seconds on average (max. = 20 seconds). Subjects in the high time pressure condition pressed the continue button after 6.55 seconds on average (max. = 7 seconds) but in most cases the next slide appeared before subjects pressed the button. The difference in average exposure duration between the low and high time pressure conditions is statistically significant (F 1,53 = 9084.26, $p < .001$). Subjects in the high time pressure condition indicated to have much less time to thoroughly inspect the target slide as compared to subjects in the low time pressure condition (respective means -.813 vs. .652, F 1,53 = 18.938, $p < .001$). Subjects in the high time pressure condition also recalled significantly less elements from the brand display as compared to subjects in the low time pressure condition (respective means are 0.968 vs. 1.652, F 1,53 = 5.935, $p < .02$). Time pressure did not raise subjects' arousal, as no differences between conditions were observed in feeling nervous (F 1,53 = 1.177, $p <$ .29) feeling at ease (F 1,53 <1) and feeling excitement (F 1,53 = 1.250, $p < .27$).

Subjects in the high motivation condition expressed significantly higher task motivation as compared to subjects in the low motivation condition (respective means 1.700 vs. .854, F 1,53 = 9.369, $p < .005$). These results indicate that the experimental manipulations were successful in creating differences in felt time pressure and task motivation, and that potential differences between time pressure conditions are due to differences in processing capacity and not due to differences in subjects' arousal (Pham 1996) or psychological stress (Svenson, Edland and Slovic 1990).

The Influence of Time Pressure and Task Motivation on Visual Attention to Brands. In the first stage of the analyses, the effect of time pressure and task motivation on visual attention to the brand display as a whole is focused upon using measures for the brand display as a whole. Average fixation duration of all fixations on the brands in the display was determined. The number of elements skipped in the display as a whole was calculated (minimum = 0; maximum = 6 x 3 = 18). The number of intra- and inter-brand saccades across all six brands per second was calculated to control for individual differences in exposure duration. Means of the visual attention measures in the cells of the experimental design are presented in Table 1, and the results of analyses-of-variance on the measures are presented in Table 2.

**********Insert Tables 1 and 2 about here**********

As hypothesised, consumers under high time pressure did speed up information acquisition. The average fixation duration was 354 milliseconds under high time pressure and 431 milliseconds under low time pressure. Consumers also filtrate significantly more under high time pressure; specifically they skip more brand areas under high time pressure (9.375) than under low time pressure (4.333). Significant strategy shifts under high time pressure can be observed as well. Under high time pressure, consumers emphasise processing-by-brand by increasing the number of inter-brand saccades that they make from .799 to 1.234. However, the increase in inter-brand saccades is not at the expense of the number of intra-brand saccades, which remains largely constant (1.510 under low time pressure vs. 1.478 under high time pressure). These results provide support for Hypothesis 1.

Overall results for task motivation are similar, but with some interesting differences. As hypothesised, the average fixation duration increases under high task motivation (from 368 milliseconds to 404 milliseconds, indicating deceleration of information acquisition. Counter to the hypothesis, the number of brand elements skipped does not differ between low and high task motivation conditions (respectively 7.000 and 7.214). As hypothesised, the number of inter-brand saccades per second decreases under high task motivation, from 1.191 to .917, which indicates decreased emphasis on processing-by-attribute. As with time pressure, we observed no differences in intra-brand saccades between low and high task motivation.

The interaction between time pressure and task motivation is significant for the number of inter-brand saccades per second (F 1,53 = 5.171, $p < .02$). The number of inter-brand saccades per second is highest for consumers with low task motivation and high time pressure (1.463). Visual attention of these consumers tends to jump from brand to brand. The number of inter-brand saccades is lowest for consumers with high task motivation and low time pressure. Visual attention of these consumers tends to go mainly from element to element within brands (1.483) and not from brand to brand (.778).

To examine skipping of brand elements in more detail, the proportion of skipped brand elements that was either the brand name, the ingredient information or the pictorial was determined for each subject. The average proportions, indicated in Table 1, sum to 1.00 per condition.

The analyses reveal no differences between time pressure conditions in skipping the brand name, but significant differences in skipping the ingredient information and the pictorial. Specifically, under high time pressure the proportion of textual, ingredient information skipped is higher (.248 under high time pressure vs. .125 under low time pressure) and the proportion of pictorials skipped is lower (.390 under high time pressure vs. .517 under low time pressure). Apparently, consumers focus on the cognitively less taxing pictorial information and skip the cognitively more taxing textual information under time pressure. This result indicates that skipping of brand elements under time pressure is non-random, and that information costs are one determinant of the rapid selections consumers make within the seven seconds they had available under time pressure.

We found significant differences between task motivation conditions in skipping brand name and pictorial information, but not in the ingredient information. Specifically, under high task motivation the proportion of skipped elements which is a brand name is lower (.322 under high task motivation vs. .402 under low task motivation) and the proportion of skipped elements which is a pictorial is higher (.484 under high task motivation and .401 under low task motivation). Skipping of brand elements under task motivation appears non-random, and is determined by the goals that consumers have. Under high task motivation, brand names are relevant for the future choices consumers expect to make, and therefore they are skipped less.

Predicting Brand Choice from Visual Attention. In the second stage of the analyses, we examine whether brand choice can be predicted from consumers' visual attention to each of the six brands in the display. Fixation duration, skipped elements, intra-brand and inter-brand saccades are used as measures of visual attention. Each consumer provided visual attention to the six brands in the display, and selects the one brand that s/he prefers most. Hence, for each consumer and for each brand in the brand display, a set of dependent and independent variables is available: brand-level attention data are nested in consumers. To account for this nested structure in the data and because the dependent variable is binary, we estimate a hierarchical logistic linear model (Bryk and Raudenbusch 1992; Bryk, Raudenbusch and Congdon 1996).

The hierarchical logistic linear model comprises a brand-level submodel and a consumer-level submodel. The brand-level model specifies:

$$Prob(Y_{ij} = 1 | \beta_{ij}) = \phi_{ij},$$

$$\log[\phi_{ij} / (1-\phi_{ij})] = \beta_{0j} + \sum_{q=1}^{5} \beta_{qj} BRAND_{qij} + \beta_{6j} FIXDUR_{ij} + \beta_{7j} SKIP_{ij} + \beta_{8j} INTRASACS_{ij} + \beta_{9j} INTERSACS_{ij}, \quad (1)$$

where Y_{ij} is the choice of consumer j of brand i, which is either 1 (chosen brand) or 0 (not chosen brand. and where Y_{ij} has a Bernoulli distribution; β_{qj} are brand-level regression coefficients; $BRAND_{qij}$ are five dummy variables distinguishing brand i (1) from the rest (0); $FIXDUR_{ij}$ measures average fixation duration of the fixations that consumer j devotes to brand i, centered around the mean of the six brands in the brand display; $SKIP_{ij}$ measures the number of brand elements that consumer j skips in brand i, centered around the mean of the six brands in the display; $INTRASACS_{ij}$ measures the number of intra-brand saccades that consumer j devotes to brand i, centered around the mean of the six brands in the brand display; $INTERSACS_{ij}$ measures the number of inter-brand saccades that consumer j devotes to brand i, centered around the mean of the six brands in the brand display.

The brand-level model estimates choice of a brand in the display as a function of a set of five dummy variables that act as design factors, and as a function of four measures of visual attention to the brands. The *BRAND* dummy variables account for systematic differences in choice of a brand from the display which are not accounted for by the visual attention patterns (Bryk, Raudenbusch and Congdon 1996). Measures of visual attention are centered around the mean of the six brands in the display, to account for differences in absolute levels of the measures between time pressure and motivation conditions. Regression weights of the visual attention measures indicate whether deviations in visual attention to a particular brand from the mean attention to all brands in the display are predictive of choice for the particular brand.

In the previous analyses, significant effects of time pressure and motivation conditions on absolute levels of visual attention to the brand display as a whole were found. These findings raise the question whether the impact of visual attention on brand choice is homogeneous across time pressure and motivation conditions, or whether the impact is heterogeneous. The impact of visual attention on brand choice is heterogeneous across time pressure and motivation conditions when the size of the regression weights for visual attention measures in the brand-level model varies across these conditions. In that case, measures of visual attention would require different interpretation depending on the specific conditions under which they are obtained. On the other hand, if the impact of visual attention on brand choice is homogenous, the size of the regression weights for visual attention measures is independent of specific experimental conditions, as specified in Hypothesis 4. If the hypothesis is supported, the meaning and interpretation of measures of visual attention is constant across experimental conditions.

To examine this issue, the following consumer-level model is specified:

$$\beta_{qj} = \gamma_{q0} + \gamma_{q1} TIME\ PRESSURE_j + \gamma_{q2} MOTIVATION_j + \gamma_{q3} INTERACTION_j + u_{qj}, \quad for\ q = 6,\ldots,9 \qquad (2)$$

where γ_{q0} are consumer-level fixed coefficients, $\gamma_{q1\text{-}3}$ are consumer-level non-randomly varying coefficients, and u_{qj} are consumer-level random effects for the measures of visual attention. Equation (2) specifies a slopes-as-outcomes model (Bryk and Raudenbusch 1992) in which each brand-level regression weight of a visual attention measure, β_{qj}, is a function of a fixed coefficient γ_{q0}, a main effect of the time pressure condition, γ_{q2} *TIME PRESSURE*$_j$, a main effect of the task motivation condition, γ_{q3} $MOTIVATION_j$, an effect of the interaction between the time pressure condition and the task motivation condition, γ_{q3} $INTERACTION_j$, and a randomly varying coefficient u_{qj}. If the effects of visual attention measures on brand choice are homogenous across time pressure and task motivation conditions, only the fixed effects, γ_{q0}, are statistically significant. If the effects of visual attention measures vary systematically as a function of time pressure and task motivation, the respective coefficients, $\gamma_{q1\text{-}3}$, are statistically significant. Substituting (2) in (1) results in the following two-level slopes-as-outcomes logistic regression model:

$$Prob(Y_{ij} = 1 | \beta_{ij}) = \phi_{ij},$$

$$\begin{aligned}\log[\phi_{ij} / (1-\phi_{ij})] = \beta_{0j} + \sum_{q=1}^{5} \beta_{qj} BRAND_{qij} + \\ (\gamma_{60} + \gamma_{61} TIME\ PRESSURE_j + \gamma_{62} MOTIVATION_j + \gamma_{63} INTERACTION_j + u_{6j}) START_{ij} + \\ (\gamma_{70} + \gamma_{71} TIME\ PRESSURE_j + \gamma_{72} MOTIVATION_j + \gamma_{73} INTERACTION_j + u_{7j}) SKIP_{ij} + \\ (\gamma_{80} + \gamma_{81} TIME\ PRESSURE_j + \gamma_{82} MOTIVATION_j + \gamma_{83} INTERACTION_j + u_{8j}) INTRASACS_{ij} + \\ (\gamma_{90} + \gamma_{91} TIME\ PRESSURE_j + \gamma_{92} MOTIVATION_j + \gamma_{93} INTERACTION_j + u_{9j}) INTERSACS_{ij},\end{aligned} \tag{3}$$

The model in equation (3) is estimated using Penalized Quasi-Likelihood (PQL) (Breslow and Clayton 1993) as implemented in the program HLM (Bryk, Raudenbusch and Congdon 1996). Table 3 provides summary information of choice for the six brands in the brand display and of the visual attention measures. Table 4 displays results of the two-level slopes-as-outcomes logistic regression model.

**********Insert Tables 3 and 4 about here**********

Inspection of the Table 3 reveals that while some brands are chosen more than others, systematic differences across the six brands are absent (χ^2 5 = 7.200, p < .206). More importantly, t-tests indicate that three of the four visual attention measures differ significantly between chosen and non-chosen brands. Compared to non-chosen brands, chosen brands contain less skipped elements (t 322 = -4.82, p < .001) they are involved in more intra-brand saccades (t 322 = 7.89, p < .001) and in more inter-brand saccades (t 322 = 5.56, p < .001). Only fixation duration does not significantly differ between chosen and non-chosen brands (t 322 = 1.12, $p < .265$) although the effect is in the expected direction.

The results of the multilevel regression analysis in Table 4, show that only one of the five dummy variables, the variable for brand 5, is statistically significant (t = 2.693, $p < .007$). This indicates that brand 5 is chosen more frequently than the others. In addition, three of the four fixed coefficients, γ_{q0}, for the visual attention measures are statistically significant. Specifically, the chosen brand receives significantly more intra-brand saccades ($t = 2.716$, $p < .007$) which are indicative of processing-by-brand, and significantly more inter-brand saccades ($t = 3.240$, $p < .002$) which are indicative of processing-by-attribute. The effect on brand choice of the number of brand elements skipped is not significant ($t = .422$, $p < .673$) [2] when the effects of the other visual attention measures are taken into account. The effect of fixation duration is insignificant as well. As hypothesised, none of the non-randomly varying coefficients of time pressure, task motivation and their interaction is statistically significant, although the effect of task motivation on the weight of inter-brand saccades approaches significance ($t = -1.900$, $p < .057$). Overall, the impact of visual attention on brand choice appears homogenous across subjects, and independent of the experimental conditions in the experiment. The random effects, u_{qj}, are all very small and statistically not significant, which indicates that there is no variance left to account for in the brand-level coefficients of the visual attention measures. The proposed model performs well, predicting 87.65% of the 324 (54 x 6) brand choices that consumers make correctly (χ^2 1 = 77.921, $p < .001$). These results provide clear support for hypothesis 3 and 4.

DISCUSSION

Ever since the seminal work of Russo (1978) and Van Raaij (1977) researchers in marketing and consumer behaviour have recognised the potential of eye movement registration to examine higher-order mental processes of consumers. Because they allow fine-grained measurement of natural attentional flow and intensity, eye movement data would offer better opportunities to develop descriptively accurate process theories of how consumers acquire information and make decisions. Because the measurement technique also allows to observe choices with respect to naturally occurring stimuli such as real brand packaging and ads, it also held the potential for systematic study of variables such as display characteristics or package design, which are known to influence consumer attention in the field, but for which the arsenal of traditional methods of the decision researcher proved insufficient (Payne, Bettman and Johnson 1993). But the technique has rarely lived up to those promises. Registration equipment was until recently very expensive, and data collection as well as data analysis cumbersome. Researchers interested in visual attention therefore had to rely mainly on human observation of eye movements through one-way mirrors (e.g., Russo and LeClerc 1994) or limit themselves to mere reporting of scan-paths without further analysis (e.g., Kroeber-Riel 1993). Our study is one of the first to examine the role of visual attention in brand choice using theoretically grounded measures derived from infra-red eye-tracking.

The results show that visual attention adapts rapidly to differences in time pressure and task motivation. Under high time pressure consumers accelerated information acquisition as indicated by the decreased average duration of their eye fixations. They also filtered information by skipping information elements on the brands. Filtering is non-random, as in particular the textual information elements of the brands were skipped more. Under high time pressure consumers also shifted to a processing-by-attribute strategy, indicated by increasing numbers of inter-brand saccades. Highly motivated consumers decelerated information acquisition, indicated by higher average fixation durations, and they de-emphasised processing-by-attribute indicated by reduced levels of inter-brand saccades. While we did not find overall differences in the number of skipped brand elements between task motivation conditions, we did find significant differences in the types of brand elements that were skipped. Specifically, when motivation was high consumers skipped less of the brand names and more of the pictorial elements.

Overall, these results provide strong evidence for the hypotheses that consumers react to decreased opportunities and increased motivation by readily adapting their information acquisition patterns in systematic ways. The speed and complexity of the processes was striking, as the high time pressure condition gave consumers only seven seconds time to scan the brand display, and to choose.

The results also show that brand choice can be predicted from observations of visual attention patterns only. Specifically, the multi-level regression analysis revealed that both intra-brand saccades and inter-brand-saccades predict brand choice.

Brands which receive more intra-brand saccades, expressive of processing-by-brand, and brands that are engaged in more inter-brand saccades, expressive of processing-by-attribute have a higher likelihood of being chosen. The effects of intra- and inter-brand saccades on brand choice were robust across time pressure and task motivation, which were shown to have significant effects on consumers' visual patterns with respect to the brand display as a whole. This result should be re-assuring to researchers interested in the attention-choice relationship, since it means that the relationship is not volatile to differences in personal and environmental conditions.

Implications and Future Research. Most research to date has investigated the impact of time pressure and task motivation on the conceptual analyses of marketing stimuli that consumers make. In a conceptual analysis, the content of stimuli is compared with pre-existing knowledge structures in memory to arrive at new inferences and to make evaluations. In attitude research (e.g., Celsi and Olson 1988; Petty, Cacioppo 1986) the role of argument quality and cues in advertising under various levels of motivation and ability have been focused upon. In decision making research (Edland and Svensson 1993; Payne, Bettman and Payne 1993) the specific decision rules consumers apply and the role of positive and negative information under time stress and other conditions have been emphasised. The focus in both of these research streams has been on the conceptual analyses that consumers make. So far, little research has studied the perceptual analyses that consumers engage in, before they proceed to the conceptual analysis stage (Greenwald and Leavitt 1984). Before consumers judge the quality of arguments and cues in ads, and before they can use positive and negative information in a choice task, they have to select and pay attention to these information elements.

Our results show that before judging the quality and valence of information contained in commercial stimuli, consumers have already been very active in filtering out information elements, in attending longer or shorter to particular elements, and in comparing information elements within and across brands. The results of these perceptual analyses are significantly and systematically related to personal and environmental conditions, and they are predictive of choice. The present results illustrate the relevance of studying the perceptual processes consumers are engaged in prior to engaging in the more higher-level cognitive processes that have been the mainstay of consumers behaviour research.

As a conceptual framework for investigating these important perceptual processes, we proposed a hierarchical model formulation in which influences at the brand level are nested within determinants of attention to the choice display as a whole. Attention theorists draw an equivalent distinction between control or determination of attention at the global level and control at the local level (Levy-Schoen 1981; Rayner 1994). Global control refers to all factors that influence how a display is scanned (such as time pressure and task motivation. regardless of the nature of the stimuli that actually are in the display. Local control factors, in contrast, are due to the relative salience of individual stimuli, and determine the likelihood that attention will shift to a particular area in the display from the current fixation point.

Global control factors typically derive from inter-individual differences, and are usually not directly influenced by marketers. They are nonetheless important, because they allow to evaluate the robustness of the effect of manageable attentional determinants across common decision situations. In addition, sometimes marketers can influence global control mechanisms. For example, store atmospherics may be able to influence the mood or arousal level of consumers, which in turn may have subtle and probably unconscious influences on how they typically scan a choice display.

Still, manageable determinants of attention are usually at the level of local control. Marketer interventions influence the salience of individual brands in the choice display, and with it the extent to which individual brands or shelf locations attract consumer attention. In our study we did not experimentally induce such interventions, but allowed for natural variation in attention drawing properties captured in the model by brand dummies. The model can easily be adapted in order to manipulate determinants of individual brand salience experimentally, which would allow to draw causal inferences about the direction of the relationship between attention and choice. Marketers can influence salience through attractive display or package design, but also through their influence on consumer familiarity with brand names, brand logos and a brand's visual appearance (Alba, Hutchinson and Lynch 1991). Local control can also be more strategic, such as when consumers actively search for attribute information that would help them optimise their choice with respect to their purchase and usage objectives. Past research in decision making has been limited to these more strategic control mechanisms induced by cost-benefit considerations (Hauser and Wernefelt 1991) or usage goals (Ratneshwar and Shocker 1991). Eye movement registration has the advantage that it can also capture global and local attentional determinants that are less strategic.

As technology progresses, marketers will be able to use increasingly precise eye-tracking measures. In this study we used visual attention measures which were aggregated across time, instead of examining the whole moment-by-moment stream of eye-movement data. Hence, the data do not allow us to examine how for instance intra- and inter-saccades develop over time, or whether skipping is more prominent in early or late stages of the choice process. Statistical techniques to analyze sequential eye-movement data are still under development, and currently rather cumbersome (e.g., Leven 1991). Future research may build on such developments and the present study to build the appropriate models and techniques.

The results of our study have important implications for managerial research on packaging and shelf lay-outs. In pretesting packaging, the attention-grabbing power of the brand name, ingredient information, pictorial and other package cues could be examined, and their ability to retain attention under various environmental and consumer conditions could be studied. Similarly, various shelf-layouts could be studied for their effectiveness in drawing and keeping attention, and in distributing attention across brands in a desired way (see also Janiszewski 1995). In such research, the effectiveness of various positions of brands relative to each other could be examined to answer questions about the optimal organisation of shelf layouts, about whether and when store brands gain from being physically close to the leading brand, or about whether brands are better off providing ingredient information in the pictorials instead of in the text. Much can be learned from the way consumers scan their environment for relevant information in order to make the decisions marketers are ultimately interested in. In such research, analysis of eye-movements may play a vital role.

Combined with the flexibility of hierarchical modeling to capture in appropriate fashion potential interactions between global and local determinants of attention and choice, the power of eye movement registration opens exiting new avenues to learn about the various ways in which the eyes are the mirror of the soul.

REFERENCES

Alba, J. W., J. W. Hutchinson, and J. G. Lynch, Jr. , 1991. Memory and decision making. In T. S. Robertson and H. H. Kassarjian (eds.*),* *Handbook of Consumer Behavior*, 1-49. Englewood Cliffs, N. J.: Prentice-Hall.

Allenby G. M. and J. L. Ginter, 1995. The Effects of In-Store Displays and Feature Advertising on Consideration Sets, *International Journal of Research in Marketing*, 12, 67-80.

Bagozzi, R. P. , 1991. The Role of Psychophysiology in Consumer Research, in T. S. Robertson and H. H. Kassarjian, eds.. *Handbook of Consumer Behavior*, Englewood Cliffs, NJ.: Prentice-Hall, 124-161.

Ben-Zur, H. and S. J. Breznitz, 1981. The Effects of Time Pressure on Risky Choice Behavior, *Acta Psychologica*, 47, 89-104.

Bettman, J. R., E. J. Johnson and J. W. Payne, 1991. Consumer Decision Making, in Thomas S. Robertson and Harold H. Kassarjian (eds). *Handbook of Consumer Behavior*, Englewood Cliffs, NJ.: Prentice-Hall, 50-84.

Breslow, N. and D. G. Clayton, 1993. Approximate Inference in Generalized Linear Mixed Models, *Journal of the American Statistical Association*, 88, 9-25.

Bryk, A. and S. Raudenbusch, 1992. *Hierarchical Linear Models: Applications and Data Analysis Methods*, Newbury Park, Ca.: Sage Publications.

Bryk, A., S. Raudenbusch and R. Congdon, 1996. *HLM, Hierarchical Linear and Nonlinear Modelling with the HLM/2l and HLM/3l Programs*, Chicago: Scientific Software International, Inc.

Celsi, R. L. and J. C. Olson, 1988. The Role of Involvement in Attention and Comprehension Processes, *Journal of Consumer Research*, 15, 210-224.

Christianson, S., E. F. Loftus, H. Hoffman and G. Loftus, 1991. Eye Fixations and Memory for Emotional Events, *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17(4), 693-701.

Cox, K. K., 1970. The Effect of Shelf Space Upon Sales of Branded Products, *Journal of Marketing Research*, 7, 55-58.

Deubel, H. and W. X. Schneider, 1993. There is No Expressway to a Comprehensive Theory of the Coordination of Vision, Eye Movements and Visual Attention, *Behavioral and Brain Sciences*, 16(3), 575-576.

Dion, K.K. , 1977. The Incentive Value of Physical Attractiveness for Young Children, *Personality and Social Psychology Bulletin*, 3, 67-70.

Dreze, X., S. J. Hoch and M.E. Park, 1993. Shelf Management and Space Elasticity, *Journal of Retailing*, 70, 301-326.

Easterbrook, J.A. , 1959. The Effect of Emotion on Cue Utilization and the Organization of Behavior, *Psychological Review*, 66, 183-201.

Edland, A., 1994. Time Pressure and the Application of Decision Rules: Choices and Judgments among Multiattribute Alternatives, *Scandinavian Journal of Psychology*, 35, 281-291.

Ericsson, K. A. and H. A. Simon, 1984. *Protocol Analysis: Verbal Reports as Data*, Cambridge, MA: MIT Press.

Gould, J. D. , 1976. Looking at Pictures, in Richard A. Monty and John W. Senders, (eds.), *Eye Movements and Psychological Processes*, New York: John Wiley and Sons, 323-345.

Greenwald, A. G. and C. Leavitt, 1984. Audience Involvement in Advertising: Four Levels, *Journal of Consumer Research*, 11, 581-592.

Grunert, K. G. , 1996. Automatic and Strategic Processes in Advertising Effects, *Journal of Marketing*, 60 (4), 88-101.

Hauser, J. R. and B. Wernerfelt, 1990. An Evaluation Cost Model of Consideration Sets, 16, 393-408.

Irwin, F. W. and W. A. S. Smith, 1957. Value, Cost and Information as Determiners of Decision, *Journal of Experimental Psychology*, 54, 229-235.

Iyer, E. S. , 1989. Unplanned Purchasing: Knowledge of Shopping Environment and Time Pressure, *Journal of Retailing*, 65(1), 40-57.

Jain, K. and N. Srinivasan, 1990. An Empirical Assessment of Multiple Operationalizations of Involvement, *Advances in Consumer Research*, 17, 594-602.

Janiszewski, C., 1995 , The Influence of Page Layout on Directing and Sustaining Attention. Working Paper, University of Florida.

Kapferer, J. and G. Laurent, 1985. Consumer Involvement Profiles: A New Practical Approach to Customer Involvement, *Journal of Advertising Research*, 25, 48-56.

Karslake, J. S., 1940. The Purdue Eye-Camera: A Practical Apparatus for Studying the Attention Value of Advertisements, *Journal of Applied Psychology*, 24, 417-440.

Kotzan J. A. and R. V. Evanson, 1969. Responsiveness of Drug Store Sales to Shelf Space Allocations, *Journal of Marketing Research*, 6, November. 465-469.

Kroeber-Riel, W., 1993. *Bild Kommunikation. Imagerystrategien fuer die Werbung*, Muenchen: Verlag Franz Vahlen.

Langlois, J. H., L. A. Roggeman, R. J. Casey, J. M. Ritter, A. Rieser-Danner and V. Y. Jenkins, 1987. Infant Preferences for Attractive Faces: Rudiments of a Stereotype? *Developmental Psychology*, 23, 3. 363-369.

Levy-Schoen, A., 1981. Flexible and/or Rigid Control of Oculomotor Scanning Behavior, in D. F. Fisher, R. A. Monty and J. W. Senders, eds.. *Eye Movements: Cognition and Visual Perception*, Hillsdale, NJ: Lawrence Erlbaum, 299-314.

Leven, W. , 1991. *Blickverhalten von Konsumenten. Grundlagen, Messung und Anwendung in der Werbeforschung*, Heidelberg: Physica Verlag.

Loftus, G. R. , 1972. Eye Fixations and Recognition Memory, *Cognitive Psychology*, 3, 525-551.

Loftus, G. R. , 1983. Eye Fixations on Text and Scenes, in R. A. Monty and J. W. Senders (eds). *Eye Movements and Psychological Processes*, Hillsdale, NJ: Lawrence Erlbaum, pp. 359-376.

Loftus, G. R. and N. H. Mackworth, 1978. Cognitive Determinants of Fixation Location During Picture Viewing, *Journal of Experimental Psychology: Human Perception and Performance*, 4, 565-572.

Payne, J. W., J. R. Bettman and E. J. Johnson, 1988. Adaptive Strategy Selection in Decision Making, *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 14, 534-552.

Payne, J. W., J. R. Bettman and E. J. Johnson, 1993. *The Adaptive Decision Maker*, Cambridge: Cambridge University Press.

Petty, R. E., J. T. Cacioppo and D. Schuman, 1983. Central and Peripheral Routes to Advertising Effectiveness: The Moderating Role of Involvement, *Journal of Consumer Research*, 10, 135-146.

Pham, M. T., 1996. Cue Representation and Selection Effects of Arousal on Persuasion, *Journal of Consumer Research,* 22, 373-387.

Ratneshwar, S. and A. D. Shocker, 1991. Substitution in Use and the Role of Usage Context in Product Category Structures, *Journal of Marketing Research*, 28, August. 281-295.

Rayner, K., 1994. Eye Movements during Skilled Reading, in J. Ygge and G. Lennerstrand (eds.), *Eye Movements in Reading*. Oxford: Elsevier, 205-218.

Roberts, J. and P. Nedungadi, 1995. Studying Consideration in the Consumer Decision Process: Progress and Challenges, *International Journal of Research in Marketing*, 12, 3-7.

Russo, J. E., 1978. Eye Fixations Can Save the World: Critical Evaluation and Comparison between Eye-Fixations and Other Information Processing Methodologies, *Advances in Consumer Research*, 5, 561-570.

Russo, J. E. and F. LeClerc, 1994. An Eye-Fixation Analysis of Choice Processes for Consumer Nondurables, *Journal of Consumer Research*, 21, 274-290.

Sperling, G. and E. Weichselgartner, 1995. Episodic Theory of the Dynamics of Spatial Attention, *Psychological Review*, 102(3. 503-532.

Svensson, O., A. Edland and P. Slovic, 1990. Choices and Judgments of Incompletely Described Decision Alternatives under Time Pressure, *Acta Psychologica*, 75, 153-169.

Svensson, O. and A. J. Maule, 1993. *Time Pressure and Stress in Human Judgement and Decision Making*, New York: Plenum Press.

Van Raaij, W. F., 1977. Consumer Information Processing for Different Information Structures and Formats, *Advances in Consumer Research*, 4, 176-184.

Viviani, P., 1990. Eye Movements in Visual Search: Cognitive, Perceptual and Motor Control Aspects, in: E. Kowler, ed.. *Eye Movements and their Role in Visual and Cognitive Processes*, Amsterdam: Elsevier, 353-393.

Wilkinson, J.B., J. B. Mason and C. H. Paksoy, 1982. Assessing the Impact of Short-Term Supermarket Strategy Variables, *Journal of Marketing Research*, 19, 72-86.

Wright, P., 1974. The Harassed Decision Maker: Time Pressures, Distractions and the Use of Evidence, *Journal of Applied Psychology*, 59, 555-561.

Wright, P. and B. Weitz, 1977. Time Horizon Effects on Product Evaluation Strategies, *Journal of Marketing Research*, 14, 429-443.

Young, L. R. and D. Sheena, 1975. Eye-Movement Measurement Techniques, *American Psychologist*, 30, March. 315-330.

NOTES

1. Russo and LeClerc (1994, p. 279 footnote) did not measure fixation duration directly.

2. In an analysis without the overall measure of skipping brand elements, and with dummy variables for skipping respectively the brand name, the ingredient information and the pictorial, none of the dummy variable reached significance.

TABLE 1
IMPACT OF TIME PRESSURE AND MOTIVATION ON VISUAL ATTENTION: MEANS

Visual Attention Measures	Total Sample	Time Pressure[1]		Task Motivation		Low Time Pressure		High Time Pressure	
		Low	High	Low	High	Low Task Motivation	High Task Motivation	Low Task Motivation	High Task Motivation
Acceleration:									
Average fixation duration in seconds	.386	.431	.354	.368	.404	.426	.435	.325	.380
Filtration:									
Number of brand elements skipped	7.111	4.333	9.375	7.000	7.214	4.545	4.333	8.800	9.375
Proportion brand name	.361	.358	.362	.402	.322	.410	.311	.396	.331
Proportion ingredient information	.195	.125	.248	.197	.194	.119	.130	.255	.242
Proportion pictorial	.444	.517	.390	.401	.484	.471	.559	.349	.427
Strategy Shift:									
Number of intra-brand saccades / sec.	1.492	1.510	1.478	1.464	1.518	1.539	1.483	1.408	1.544
Number of inter-brand saccades / sec.	1.049	.799	1.234	1.191	.917	.821	.778	1.463	1.020
Cell Size	54	23	31	26	28	11	12	15	16

[1] Means of the measures are reported.

TABLE 2
ANALYSES OF VARIANCE ON VISUAL ATTENTION MEASURES

Visual Attention Measures	Time Pressure [1]		Task Motivation		Interaction	
	F value	p value	F value	p value	F value	p value
Acceleration:						
Average fixation duration	12.714	<.001	2.855	.049	1.143	.145
Filtration:						
Number of brand elements skipped	92.751	<.001	.141	.355	.665	.210
Proportion brand name	.008	.464	5.948	.009	.270	.303
Proportion ingredient information	13.542	<.001	.001	.487	.136	.357
Proportion pictorial	8.394	.003	3.577	.032	.013	.455
Strategy Shift:						
Number of intra-brand saccades / sec.	.101	.376	.127	.362	.759	.194
Number of inter-brand saccades / sec.	25.215	<.001	7.585	.004	5.171	.014

[1] All df's are 1,53. *F*'s are tested one-sided.

TABLE 3
INFORMATION OF BRAND CHOICE AND VISUAL ATTENTION MEASURES

	Number of times chosen brand	Number of times non-chosen brand
Brand 1	9	45
Brand 2	10	44
Brand 3	7	47
Brand 4	6	48
Brand 5	15	39
Brand 6	7	47

Visual Attention Measures	Centered means of chosen brand	Centered means of non-chosen brands
Fixation duration	.028	-.005
Skipping elements	-.352	.070
Intra-brand saccades	2.176	-.435
Inter-brand saccades	.963	-.193
	(n = 54)	(n = 270)

TABLE 4
TWO-LEVEL SLOPES-AS-OUTCOMES LOGISTIC REGRESSION MODEL: THE ATTENTION-CHOICE RELATIONSHIP

Fixed Effects	Coefficient	se	t ratio	p value
Intercept, γ_{00}	-2.990	.615	-4.856	.000
Brand 1, γ_{10}	.669	.749	.894	.371
Brand 2, γ_{20}	.321	.867	.371	.711
Brand 3, γ_{30}	.653	.783	.834	.404
Brand 4, γ_{40}	.399	.829	.481	.630
Brand 5, γ_{50}	2.093	.777	2.693	.007
Fixation duration, γ_{60}	4.564	3.195	1.360	.174
Time pressure, γ_{61}	-1.986	3.000	-.617	.537
Task motivation, γ_{62}	-.819	2.987	-.277	.782
Interaction, γ_{63}	-1.188	1.502	-.723	.469
Skipping elements, γ_{70}	.354	.840	.422	.673
Time pressure, γ_{71}	-.873	.883	-.990	.323
Task motivation, γ_{72}	-.383	.879	-.436	.662
Interaction γ_{73}	-.227	.433	-.526	.599
Intra-brand saccades, γ_{80}	.586	.216	2.716	.007
Time pressure, γ_{81}	-.211	.258	-.816	.415
Task motivation, γ_{82}	.117	.258	.454	.650
Interaction, γ_{83}	.024	.128	.187	.852
Inter-brand saccades, γ_{90}	1.156	.3547	3.240	.002
Time pressure, γ_{91}	-.650	.427	-1.525	.127
Task motivation γ_{92}	-.816	.430	-1.900	.057
Interaction, γ_{93}	-.066	.213	-.308	.758

Random Effects	Variance Component	df	χ^2	p value
Fixation duration, u_{6j}	2.638	47	28.117	>.500
Skipping elements, u_{7j}	1.010	47	24.910	>.500
Intra-brand saccades, u_{8j}	.098	47	23.058	>.500
Inter-brand saccades, u_{9j}	.340	47	33.989	>.500

FIGURE 1
CONCEPTUAL FRAMEWORK

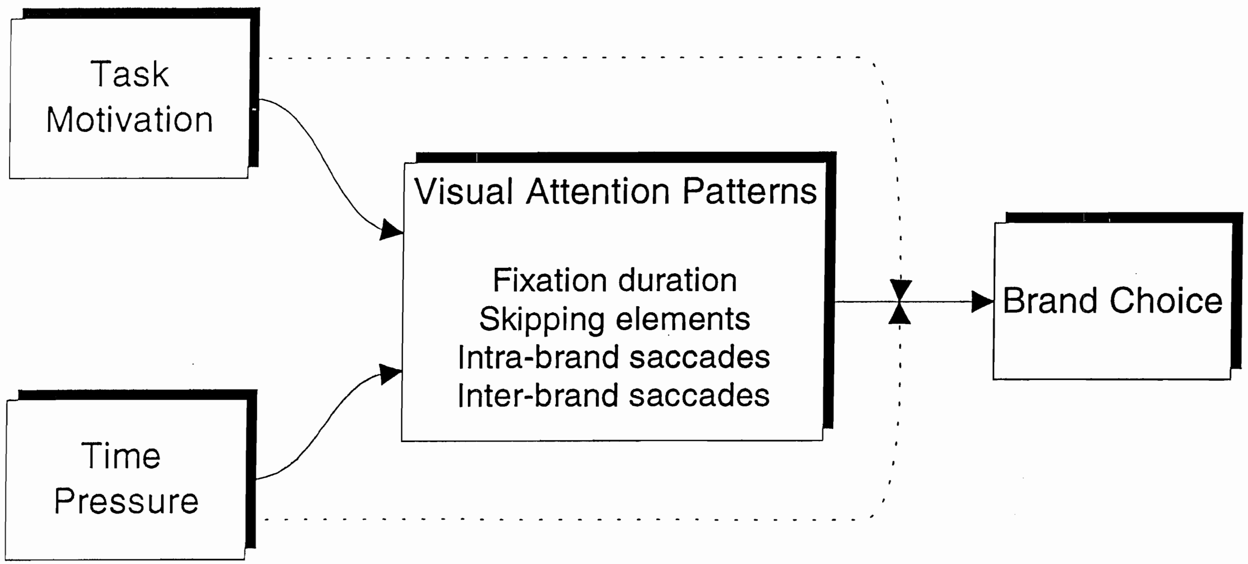

FIGURE 2
INFORMATION ELEMENTS ON THE BRAND DISPLAY

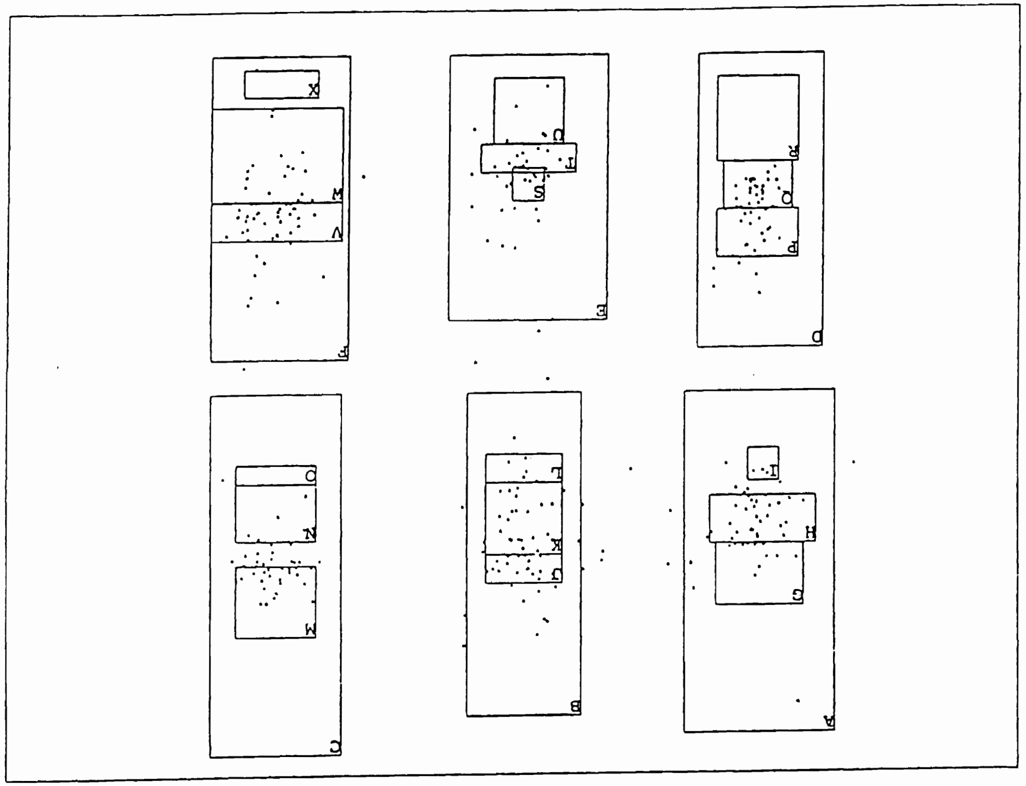

FIGURE 3
A HYPOTHETICAL VISUAL ATTENTION PATTERN