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Preference in the Harried Eye of the Beholder : The Effect of Time Pressure and Task Motivation on Visual Attention to Brands

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ABSTRACT

We report a study in which eye-tracking data were gathered to examine the impact of time-pressure and task motivation on the flow of visual attention during choice processing from a naturalistic stimulus-based product display. We find patterns of adaptation of visual attention to time pressure in terms of acceleration, filtration, and strategy shift that have not been reported previously. In addition we find, regardless of condition, strong correlations between visual attention to the brands in the choice set and preference for the brands. Results are discussed in terms of strategic and non-strategic information acquisition during stimulus-based choice, and implications for attention theory are offered.

The Effect of Time Pressure and Task Motivation on Visual Attention to Brands

Consumers make multiple choices under time pressure daily; some important, others trivial. Many choices take place in store environments where several brands compete for consumers' attention and consideration. But despite the enormous amounts of money marketers spend on attracting and guiding consumers' attention to their products (Janiszewski and Bickart 1994), the role of attention in consumer choice has generated relatively little research attention.

Moreover, although todays harried consumers experience it frequently, and "... in spite of its potential importance, relatively little research has focused on how time pressure affects decisions about multi-attribute alternatives" (Payne, Bettman and Johnson 1993, p.38). While time pressure reduces the consumer's opportunity to attend to brands, other factors such as consumer involvement with the choice task increase the motivation to attend to brands (Celsi and Olson 1988). Research has not yet examined whether and to what extent increased levels of motivation may compensate for decreased levels of opportunity to attend to brands. Research examining heterogeneous effects of time pressure on visual attention, as a function of factors such as consumer motivation with the task, is absent. In this study we examine the nature of adaptation of consumers' visual attention patterns to time pressure and task motivation.

Most of what we know about the nature of stimulus-based choice processes comes from studies using verbal protocol or information display board methodologies (Payne, Bettman and Johnson 1993) which, despite their contribution to our knowledge about how consumers adapt to task and context constraints, do not allow a natural flow of attention over the decision alternatives. The most direct way to measure attentional flow is eye tracking, which has long been recognized as a complementary method of gathering data on information acquisition in choice tasks (Russo 1978), but has until now received much less attention than more traditional methods. More specifically, very few data are available on whether and how visual attention patterns adapt to constraints on the decision making process. Ours is the first study to analyze adaptation of visual attention patterns to time pressure and task motivation using eye tracking methodology.

TIME PRESSURE AND TASK MOTIVATION

"Real" choice sets are crowded with salient non-attribute elements which may guide or distract consumer attention. Under such conditions information acquisition is not entirely strategic. The way in which a consumer visually explores a product display is partially driven by global, culturally determined, scanning routines and by salient elements of the display (Janiszewski 1995; Levy-Schoen 1981). Visual scanning of a naturalistic choice display is a free-flowing activity, and we are not always aware of what our eyes exactly do. It is important to understand how information search through visual scanning occurs. Ultimately, this increased understanding should allow marketers to design product packaging and information displays that better manage the flow of consumers' attention (Janiszewski 1995), and that increase the effectiveness of communication efforts.

One of the dominant findings in process-oriented decision research has been that decision makers tend to adapt strategically to the constraints imposed by the decision making context and to their own cognitive limitations (Payne, Bettman, and Johnson 1993). One such constraint, prevalent in many consumer decisions, is time pressure. Time pressure is the subjective experience of a shortage of cognitive resources in order to perform a task in a preferred or optimal manner (Edland and Svensson 1993). Coping with time pressure therefore assumes some kind of change in the way information is processed. Prior research has found evidence for three main coping strategies, although the evidence for each has been somewhat equivocal. Processing may adapt through acceleration, which involves a general speeding up of cognitive activity, without changing the way in which information about the decision alternatives is acquired. Research has also found evidence for filtration, which involves the deliberate decision to ignore some -- less important -- information in the face of time constraints, and only to concentrate on the information that is deemed most important for arriving at a "good" decision. In both cases the overall acquisition strategy does not change. It will either be executed faster, or will ignore some of the relevant information. A third way to adapt is by changing one's information acquisition strategy, i.e., strategy shift. In decision making research, strategy shifts from more compensatory (and therefore "within alternative") to more non-compensatory strategies (which is more "between alternative") have been reported

(e.g., Payne, Bettman, and Johnson 1988; Svensson, Edland and Slovic 1990; Zakay 1985), although the evidence to date is not very convincing yet (Payne, Bettman and Johnson 1993). Task motivation on the other hand has been shown to increase the amount of information searched (Celsi and Olson 1988), and to lead to more compensatory processing and a more complete weighing of all the available information, which should result in slowing down the information search. We examine the extent to which strategic adaptations of visual attention patterns are found, and whether useful indicators of acceleration, filtration and strategy shift can be derived from eye tracking data.

Preference in the Eye of the Beholder. Two- or multi-stage models have been formulated in which decision making is regarded as an active process in which one alternative is gradually -- or in a step-wise fashion -- differentiated from the others until it is finally chosen. As a result of this process, the brands that are finally considered receive much more attention than the brands rejected early in the process. Therefore one should expect a monotonically increasing relationship between the amount of attention devoted to the different alternatives in a choice set and the order in which they are preferred by the consumer. Of particular interest here is the extent to which the selection process that takes place is dependent on time pressure and task motivation.

EYE TRACKING INDICATORS OF VISUAL SEARCH

Information display board methods can distinguish between acceleration, filtration and strategy shift because the display board specifies all relevant information for the task in an idealized manner such that frequency, duration and order of sampling of each information unit can be assessed separately. Our eye tracking study uses a naturalistic brand display, for which this is not possible. We therefore have to develop measures of visual attention and of adaptation to contextual factors that take into account the more naturalistic and "messy" nature of the data.

In Figure 1 the actual brand display used in the current study is shown.

What eye tracking data have in common with data from information display board research is that they should be treated as measures of information acquisition -- although to a lesser extent under strategic control -- rather than as a direct reflection of cognitive processes (cf. Russo 1978; Viviani 1990). Consistent with information display board research and with

recently published eye tracking research (Russo and Leclerc 1994), we define as the unit of observation each saccade or "jump" from one meaningful area of the brand display to another. We define as relevant areas all the brands in the display, as well as the major areas within each stimulus brand's package (i.e., brand name, textual information, and package illustration / pictorial). Exact definitions follow in the Method section.

FIGURE 1
Brand Display

This approach allows us to focus on the attention switching patterns between areas, both within and between brands, and we derive several summary measures of information acquisition, which we use to assess the impact of time pressure and motivation.

Acceleration. Our subjects are asked to make a choice from a choice set of six brands of shampoo, and we collect eye tracking data while they acquire information in order to make that choice. We define the time difference between the exposure to the brand display and the first fixation on each brand (or any of its relevant areas) as that brand's "starting time." We expect to observe a decrease in average starting time across brands under conditions that lead to acceleration of information acquisition, and an increase in the average starting time when the

context forces the consumer to decelerate. In addition we observe the average number of switches per time unit within a brand and between brands. When information acquisition accelerates, the average number of switches per time unit should increase for both measures. When it decelerates, both should decrease.

Filtration. Adaptation through filtration implies that the decision maker ignores some relevant information while acquiring information in order to make a choice. First, because we define three relevant areas within each of the six brands, we can observe the total number of within-brand areas that are skipped as a global measure of filtering. Second, to the extent that each within-brand area contains some decision-relevant information, we can use the number of brands that are entirely scanned, i.e., for which each of the three key areas are fixated, as a measure of absence of filtration. We will examine for both these indicators the extent to which they adapt to contextual constraints. Highly motivated decision makers should filter less, while time constrained decision makers should filter more. Third, we can also measure the proportion of skipped areas that contain, respectively brand names, ingredient information and package pictorials. We expect highly motivated decision makers to concentrate on the verbal information on the packages, while decision makers under time pressure will tend to ignore the verbal information.

Strategy Shift. Decision-making research reports that compensatory processing increases when decision makers are highly motivated, and decreases when they work under time pressure. The proportion of within-brand switches relative to the total number of switches observed during information acquisition serves as a measure of within-brand processing. Only when this proportion is high it is reasonable to assume that the decision maker engages in a compensatory decision strategy. If visual attention patterns reflect strategic and adaptive information acquisition the proportion of switches that are within-brand should increase with high motivation and decrease with high time pressure.

Scanning-Preference Relationship. We examine the extent to which emerging preferences are reflected in the way information about the brands is acquired under the different contextual constraints. We measure the relative frequency of fixations and the relative gaze duration as generalized indices of the amount of attention given to each brand (Friedman 1979).

If there is a monotonic relationship between preference and attention, rank-order correlations between the preference ranking of the brands and both measures of attention should be high.

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.

Design and Stimuli. The stimuli were four color slides each showing a choice set consisting of pictures of six unfamiliar brands in four product categories: rice, shampoo, canned soup, and salad dressing. All brands used in the study were Belgian brands, unknown to the Dutch 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, shown in black and white in Figure 1.

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 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 emphasized 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 7 seconds. The instructions mentioned that the subjects would not have much time to inspect the slides.

Motivation was manipulated in two ways. Before being exposed to the first slide, subjects in the High 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 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.

Procedure. Subjects participated individually. Upon entering the experimental room, they read a booklet containing the instructions. They were explained 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 motivation. Then the subjects were seated in front of the screen on which the stimulus slides would be projected from behind. They were instructed to place their chin on a small chin rest. Eye movements were recorded by an infrared camera located at the subjects' left side, in order not to interfere with normal viewing behavior. The camera was calibrated on the subject's right eye. During measurement the position of the fovea was recorded fifty times per second.

The onset of each slide was announced through head phones. Each time, subjects were exposed to a slide with the six brands from one of the four conditions. The critical slide (shampoo) was always in second position. When the choice set had disappeared from the screen, 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 preference by naming the letter of the box that corresponded to the brand they had chosen. Subjects pressed a button when they were done, in order to see the next slide.

After making their final choice, subjects received a questionnaire. First, memory for the brands and products on the slides was assessed. Then subjects answered manipulation check questions about experienced time pressure and task motivation, including six items from Kapferer and Laurent's (1985) involvement scale. Then they saw the slide with the six shampoo brands again, and were asked to rank the brands in order of preference. The most preferred brand corresponded to the brand chosen earlier for all subjects.

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 motivation manipulation.

RESULTS

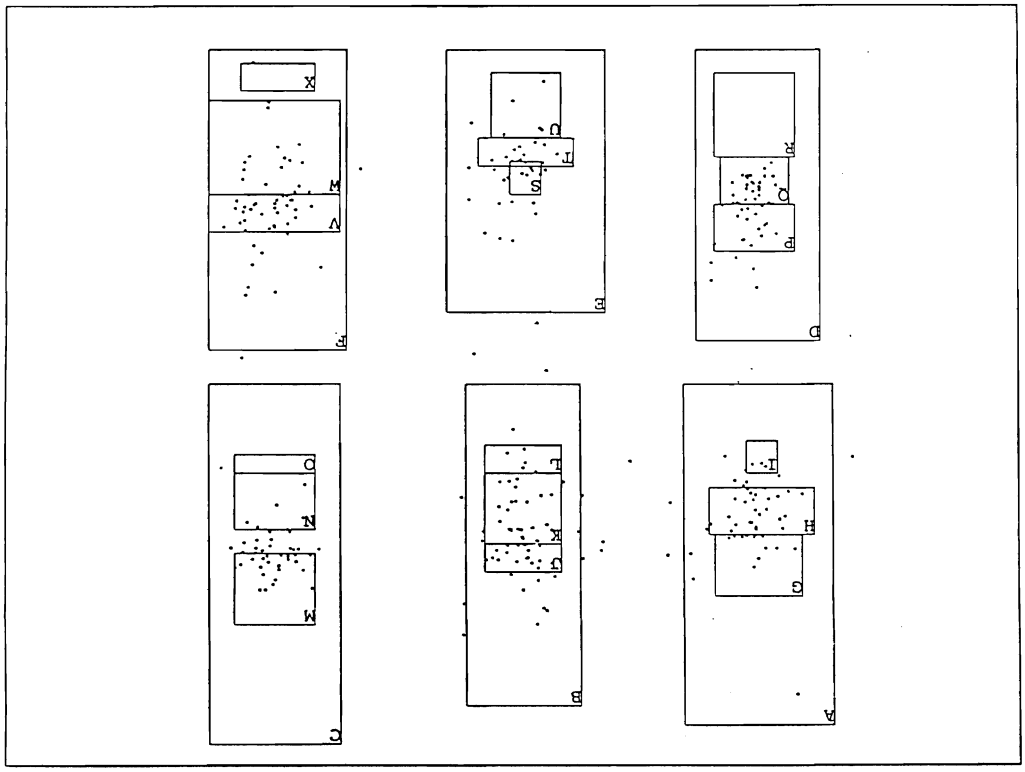
Manipulation Checks. As expected, the motivation manipulation has a significant effect on the motivation to form a good judgment about the brands (F (*1,63*) = 4.01, p < .05), and on the felt involvement of subjects (F (*1,63*) = 4.97, p < .05). The time pressure manipulation had a significant impact on the experience of having sufficient time to make a good judgment about the brands (F (*1,63*) = 15.65, p < .005), with subjects in the 7 seconds condition experiencing significantly less time to evaluate as compared to subjects in the 20 seconds condition. None of the interactions is significant. Consistent with these results, subjects in the Low Time Pressure condition remembered significantly more elements from the shampoo slide (X = 1.54) as compared to subjects in the High Time Pressure conditions (X = 1.03) (F (*1,63*)= 3.84, p=.06).

Analysis of eye tracking data. As shown in Figure 2 each shampoo bottle was defined as a separate "major" area of the screen (areas A through F in Figure 2). Within each of these "major" areas three sub-areas were defined, each corresponding to a salient element of the package: the brand name (areas I, L, O, P, T, and X in Figure 2), the pictorial (areas G, K, N, Q, S, and V in Figure 2), and ingredient information (areas H, J, M, R, U, and W in Figure 2). The number of observations on each area and sub-area was counted and utilized to form indicators of visual attention, and of adaptation to contextual factors.

To assess acceleration, the "average starting time" (see Table 1) was determined. First, the time between exposure to the brand display and the first fixation on each of the six brands was determined. Next, the average of these six "starting times" was calculated. Decreasing average starting time indicates acceleration of processing.

To assess filtration, several measures of skipping were created. First, the total number of areas skipped, that is, that received no fixation at all was determined. Next, we determined the proportion of skipped areas that contained the brand name, pictorial and ingredient information respectively. These measures indicate the extent and locus of filtration; they allow us to examine which information is filtered out by a subject in order to cope with the task constraints. Finally, for each subject it was determined how many brands were scanned entirely, that is, the number of brands for which none of the relevant areas was skipped. The more brands that were scanned entirely, the less filtration took place.

FIGURE 2
Designated Areas on the Brand Display



To assess strategy shifts in information acquisition, three measures based on saccades were constructed. First, the number of switches, saccades, within the six brands per second was determined for each subject. This indicates the extent of processing-by-brand that subjects are engaged in. Second, the number of switches between the six brands per second was determined. This indicates the extent of processing-by-attribute. Third, the ratio of the number of switches within brands to the total number of switches made per second was determined. This indicates the extent to which processing-by-brand dominates over processing-by-attribute. Higher values of the first and third measure, and lower values of the second, indicate simplifying information acquisition strategies.

In Table 1, the average starting times, the number and proportions of areas skipped, and the average number and proportion of switches in the four conditions of the experimental design are presented.

TABLE 1
Effect of Motivation and Time Pressure on Visual Attention

Measures	Low Motivation Time Pressure		High Motivation Time Pressure	
	Low	High	Low	High
Average starting time	2.53	1.45	3.76	2.31
Total number of areas skipped	6.62	10.37	5.38	10.74
Proportion Brand Name	.40	.38	.31	.33
Proportion Ingredient Information	.15	.27	.15	.26
Proportion Pictorial	.45	.35	.54	.41
Number of brands entirely scanned	1.85	.26	2.23	.16
Within-brand switches per second	1.46	1.30	1.36	1.46
Between-brand switches per second	.77	1.35	.70	.99
Ratio of within-to-total switches	.66	.49	.66	.60

Acceleration. When motivation is high, the average starting time of the first fixation on the brands, is significantly later than the starting time under low motivation ($F(1,52) = 10.75$, $p < .005$). When time pressure is high, the average starting times decrease ($F(1,52) = 17.80$, $p < .005$). The interaction between time pressure and motivation is not significant ($F(1,52) = .34$, ns.)

Filtration. Filtration appears to be influenced mainly by time pressure. The total number of within-brand areas skipped ($F(1,63) = 18.60$, $p < .005$) was higher under high time pressure than under low time pressure. In addition, subjects under high time pressure were more likely to skip ingredient information ($F(1,63) = 13.25$, $p < .005$), and even entire brands ($F(1,63) = 61.64$, $p < .005$), but less likely to skip the package illustrations ($F(1,63) = 9.10$, $p < .005$) than subjects under low time pressure. These results are clearly indicative of smaller consideration sets (brands that are not looked at can not be chosen) and a more superficial information search within the brands that are scanned. Motivation has qualitatively different effects: Highly motivated subjects are less likely to skip brand names and ingredient

information than subjects with a low motivation. Higher motivation does not merely increase overall attention; it also directs the eye to information that "promises" to be more diagnostic for brand choice (cf. Easterbrook 1959).

Strategy Shift. Under conditions of high motivation the number of between-brand switches per second decreases ($F(1,63) = 10.70$, $p < .005$), and the ratio of within-to-total switches increases ($F(1,63) = 9.61$, $p < .005$). Under high time pressure, the number of between-brand switches per second increases ($F(1,63) = 34.59$, $p < .005$), and the ratio of within-to-total switches decreases ($F(1,63) = 28.10$, $p < .005$). These significant main effects are indicative of a relative decrease in processing within-brand under conditions of high time pressure and low motivation, and a relative increase in processing between-brands under conditions of low time pressure and high motivation. The results indicate that free-flowing visual attention patterns adapt strategically and very quickly to the constraints imposed by the situation.

The significant interaction between motivation and time pressure for the ratio of within-to-total switches ($F(1,63) = 4.95$, $p < .05$), and the marginally significant interaction for the number of between-brand switches per second ($F(1,63) = 3.83$, $p = .055$) support this interpretation. Table 1 indicates for instance that the lowest extent of processing-within-brands occurs under high time pressure and low motivation (ratio of within-to-total switches is .49).

Brand Preferences. As expected, motivation and time pressure and their interaction had no overall effects on the preference orders of the shampoo brands. Hence, the manipulations did not render any particular brand more salient or attractive. We hypothesized that subjects' preference scores for the brands would be significantly correlated with their gaze durations and fixation frequencies to the brands. Table 2 presents for each of the six brands separately, Spearman rho correlation coefficients between the preference rank order of the brands (1 to 6, from most to least preferred) and respectively the relative gaze duration and relative fixation frequency. Inspection of Table 2 shows that in 11 out of 12 cases, the correlation is statistically significant. In addition, we calculated the relative gaze duration for each position in the preference order (from 1 to 6) across brands. The proportion of total scanning time spent on the most preferred brand was 27.7%. The second most preferred brand receives 16.5% only, the

third receives 14.7%. the fourth, the fifth and the sixth preferred brands receive 14.7%, 13.1%, and 12.5% respectively.

TABLE 2
Rank Order Correlation of Brand Preference with
Relative Gaze Duration and Fixation Frequency

Brands	Average preference position	Spearman rho Relative gaze duration [1]	Spearman rho Relative fixation frequency
A	3.77	-0.216 a	-0.328 c
B	2.89	-0.523 c	-0.572 c
C	3.59	-0.355 c	-0.158
D	4.30	-0.377 c	-0.361 c
E	3.25	-0.506 c	-0.558 c
F	3.20	-0.358 c	-0.326 c

[1] Significance levels, a = $p < .05$, b = $p < .01$, c = $p < .005$.

A 2 x 2 (x 6) MANOVA, with motivation and time pressure as between-subjects factors, and the relative gaze duration for each of the six preference positions (1 to 6) as the within-subjects factor, revealed no significant interactions, but the effect of preference position was highly significant ($F(5,315) = 23.44$, $p < .001$). In other words, the drop in relative gaze duration is homogenous across the two experimental factors in the design. As the brands were completely unfamiliar to the subjects, preference could only develop during scanning of the choice display. Even under those conditions we find a surprisingly strong relationship between attention and preference.

DISCUSSION

To our knowledge the present study is the first to examine contextual constraints on information acquisition using eye tracking and a naturalistic choice display. Our results reveal that to a surprising extent free-floating visual attention adapts to the constraints imposed by the nature of the choice task. We found clear evidence for acceleration, filtration and strategy shifts in visual attention under time pressure and also under low motivation. For instance, under time pressure, consumers scan the brand display faster, indicating acceleration, they skip more areas of the brand display, and even complete brands, indicating filtration, and they shift more to

information acquisition between-brands as compared to information acquisition within-brands, indicating strategy shift.

The results support the generalizability of findings from the contingent processing framework (Payne, Bettman and Johnson 1993) to information acquisition processes, and they go beyond them. While behavior in the contingent processing framework is largely strategic, the speed with which information acquisition was performed in our study suggests that consumers' visual attention adapted largely non-strategically to the contextual factors. In addition, our results suggest that, at least in the present context, high motivation compensates in part for high time pressure, since the overall impact of the two factors on patterns of visual attention were very similar, but reversed.

Our results diverge from the finding in eye movement research that scan patterns are only loosely controlled, and that instead they are driven by global overlearned scanning routines (e.g., top-bottom, left-right), and by salient elements in the display. It may be that scanning-for-search induces a higher level of control of eye movements than scanning in service of other cognitive tasks. In addition, we examined visual attention patterns at higher levels of aggregation than is frequently done in eye tracking research. It may well be possible that visual attention patterns are strategically controlled at higher levels ("What do I look at next?") while individual fixations and saccades are more heavily determined by salient display elements and global scanning routines. Finally it could be that the "adaptive behavior" we observed is not strategic adaptation in strict sense, but that consumers over time have learned several scanning routines in response to environmental conditions, and that this "procedural knowledge" is automatically called for when those conditions repeat themselves. We currently paln research in which detailed analyses of scan patterns are combined with other process measures of information acquisition in order to investigate these possibilities.

Another interesting finding is the high correlation between preference and amount of attention devoted to the brands. This would not be surprising in choice situations where the brands vary in familiarity, as familiarity is probably a causal factor in both attention attraction and in preference. This explanation is unlikely to hold for our results because all brands were equally unfamiliar and the choice proportions show that none of the brands was particularly

more attractive than any other. It seems that even emerging preferences at first contact are closely related to visual attention, so that preference is, in a way, indeed in the eye of the beholder. Several mechanisms may account for the obtained attention-preference relationship. If consumers engage in a sequential selection process in which brands are dropped until a single brand, the most preferred one, remains, or in which an early preferred brand is compared with the other brands, a significant relationship between preference order and attention results. Then, a significant attention-preference relationship is a concomittant or epiphenomenon of higher order cognitive choice processes. However, if consumers tend to devote more attention to preferred stimuli than to non-prefered stimuli, for hedonic reasons, because it is more enjoyable to "consume" attractive or pleasurable than unattractive or unpleasurable stimuli, a significant attention-preference relationship is obtained as well. Then, the relationship is the outcome of motivated search for positive affect. While research supporting the first explanation comes from research on adaptive decision making and consideration set formation (e.g., Payne, Bettman and Johnson 1993), some research in developmental and social psychology supports the second explanation. For instance, children and adults tend to gaze longer at attractive as compared to unattractive faces (e.g., Dion 1977), and even two month old infants already prefer attractive over unattractive faces (Langlois et al. 1987).

Unfortunately, only information about starting times, eye fixations and switches aggregated across time was available in the present study. Hence, we cannot determine whether and how eye fixations and saccades change in the course of time, and we cannot distinguish more cognitive from more hedonic explanations of the attention-preference relationship. Future research is needed to provide more insight in the mechanisms underlying attention-preference relationships.

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