Do not forget about the price tag! A neuroscientific approach to delve into the influence of colour and price reduction on product perception

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Abstract

Information cues associated with pricing schemes represent a major driver affecting consumer perception. Minor variations of the information set bear a significant influence at the cognitive level directly influencing the consumer's automatic responses and in turn her behaviour. The present study analysed such reactions to different combinations of colour and price reduction schemes through the consumer neuroscience tools including the analysis of physiological, behavioural, as well as self-reported cognitive responses. An experimental investigation involving 80 subjects in a 2x2 between subject design was set out to compare responses to high-priced and low-priced products associated with a price reduction scheme (relative vs absolute price discount) and coloured price tag (long-wavelenght vs black-coloured). Findings show how the combination of orange and percentage-off price reduction tended to attract the ocular attention for longer time spans and induce higher returning rates. Whereas, reward-related cortical activations showed how black-priced labels affected positively the observer across the two product categories. Furthermore, long-wavelength coloured price tags resulted to elicit higher arousal than black ones. Lastly, self-reported data pointed to a higher perceived positive affect related the low-priced product discounted in relative terms. The discussion focuses on research and managerial implications.

Introduction

Several established lines of evidence suggest that significant alterations of consumer decision making outcomes are due to minor modifications of the information set provided to the decision maker (Gatewood and Perloff 1973; Krishna 1991; Zeithaml 1982). A large volume of published studies investigates the consumer automatic behavioural responses to heuristic cues with the goal of a deeper understanding of the causal mechanisms driving consumer psychology and choice. Such cues refer to mental shortcuts employed in the decisional process based on previous experience and aimed at limiting demands for thinking. Examples might be found in the impact on consumer judgments varying according to descriptive product labels (Levin and Gaeth 1988), message framing represented either as gains or losses (Maheswaran and Meyers-Levy 1990) or product choice variation due to the perceived stock quantity (Tan and Hwang Chua 2004).

Information cues associated with pricing presentation represents a further major driver affecting consumer perception. The importance of the pricing lever is not unknown to both marketing research and business practitioners. Indeed, it is common for consumers to infer a direct relationship between the proposed price and the related product quality (Cronley et al. 2005; Kardes et al. 2004). Previous studies on this topic have shown how consumer information processing may be affected from elements such as price reduction schemes (Chen, Monroe, and Lou 1998), visual presentations in terms of physical distance between prices (Coulter and Norberg 2009), auditory encoding of price sounds (Coulter and Coulter 2010), or coloured labels (Puccinelli et al. 2013).

Different theoretical lenses and applied methodologies have been adopted in the study of consumer perceptive and affective mechanisms to pricing strategies, ranging from behavioural psychology to cognitive neuroscience (Ahmetoglu, Furnham, and Fagan 2014; Perrachione and Perrachione 2008). The latter field recently experienced a renewed interest in the realm of marketing due to the possibility of delving into automatic cognitive processes through the individuals' neurophysiological responses (Ariely and Berns 2010; Fugate 2007; Morin 2011). These bodily reactions are often hypothesised as an expression of unconscious responses driving different choice mechanisms (Bettiga, Lamberti, and Noci 2017), hence a potential subject of study to gather direct information about the consumer's automatic reactions to marketing stimuli. Early studies belonging to the consumer neuroscience branch have highlighted how purchasing behaviour can be modulated by in-store affective states (Groeppel-Klein 2005) or that distinct neural activations may anticipate gains and losses prior to the purchase decision (Knutson et al. 2007). However, to the best of our knowledge, no previous evidence in this field delved into the influence of price reduction schemes on the consumers' automatic and perceptive mechanisms. Such swift mechanisms, central to trigger a purchase decision, result to be a suited subject of investigation through neurophysiological tools, which provide the possibility to carry out measurements in the moment when the actual behaviour is triggered with a high temporal precision.

The current research study is aimed at expanding such research stream relying on consumer neuroscience research methods. Specifically, the present paper delves into the interrelation between physiological and behavioural responses to two different combinations of information cues related to a product offer, namely the colour of the product price tag and the related promotion scheme. The major contribution of the present work lies in the integration of physiological and behavioural measures related to different visual information cues to ultimately enrich the marketing literature concerned with pricing perception theories. This research set out to investigate physiological and behavioural patterns in terms of affect, attention, engagement, desirability, and information search patterns in conjunction with the display of two products associated to different information cues in a controlled laboratory environment.

Literature framework

The last three decades have seen a growing trend towards the study of the role of affective states as well as perceptive mechanisms in the entire discipline of marketing research (Bagozzi, Gopinath, and Nyer 1999; Erevelles 1998). The interest has been sustained by arguments and evidence highlighting limitations in former cognitive models describing consumer decision making patterns as sheer cognitive acts performed by rational agents (Coleman and Fararo 1992). Deviances from the rational choice model were evidenced through shortcuts employed in the buyer decision process modulated by the information available or contingent factors (Bettman, Luce, and Payne 1998; Tversky and Kahneman 1973). The study of affective states and perceptive mechanisms in marketing models is hence intended to provide a richer understanding of the drivers underlying consumer behaviour and motivation.

Traditionally, consumer research fostered the study of these behavioural mechanisms inferring consumer motivations and attitudes through observation and survey research (Poels and Dewitte 2006; Walker and Dubitsky 1994). However, the study of implicit mechanisms occurring at the preattentive level is associated with a certain degree of complexity since the respondent is often unaware of the automatic processing. To overcome such issue, studies in the consumer neuroscience research stream aim to complement self-reported measures with behavioural and physiological responses. Physiological measurement instruments allow real time measurement that can be in translated in turn into a higher granularity to the assessment data. In this sense consumer neuroscience may provide further contributions to consumer research in terms of description of transient behavioural processes unconscious to the respondent. Early studies provide examples of how neural activations could provide insights about the impact of brands on product evaluation (McClure et al. 2004), affective engagement in the advertising processing (Marci 2006) or both individual and general population's preferences (Boksem and Smidts 2015). Pricing schemes and the related consumer decision making dynamics are a further subject of investigation in both consumer psychology and consumer neuroscience research, as discussed in the following.

1. Price reduction schemes

A major line of research in marketing literature focuses on how different implementations of promotions influence consumers' perceptions and purchase decisions to ultimately stimulate sales (Chen et al. 1998; Grewal, Gotlieb, and Marmorstein 1994). Often investigated typologies of price reduction are represented by discount presented in absolute terms from the reference price (i.e. euro-off reduction) or relative terms (i.e. percentage-off reduction). (DelVecchio, Lakshmanan, and Krishnan 2009; Krishna et al. 2002) . Both typologies generally require an explicit display of the sale amount along with the original reference price (e.g. a list priced product of 50€ discounted by 10€).

Previous research has shown different effects elicited by the adoption of the price reduction scheme. (Chen et al. 1998) show that for high-priced products subjects tend to perceive a price reduction framed in absolute terms as more valuable than the same price reduction framed in percentage terms, whereas the opposite was shown to take place for low-priced products. Comparable findings are reported by (DelVecchio, Krishnan, and Smith 2007) who empirically show how cents-off price reductions tend to be perceived results in lower price expectations than a percentage-off discount. Such heuristic mechanisms are rooted in framing and mental accounting theories, whereby individuals perform suboptimal decisions driven by biases and systematic departures from rational behaviours (Heath, Chatterjee, and France 1995; Thaler 1985).

Data from several studies in the field of experimental psychology suggest that that quantitative numerical processing is often affected by the relative distance between the compared amounts (Dehaene 1992; Dehaene and Akhavein 1995). Specifically, it is evidenced how the difference between two numbers is inversely proportional to their size. In other words, the perceived difference between two quantities decreases with the increasing of the quantity size. Accordingly, we assume that pricing perception is affected depending on the size of the original reference price, distinguishing between high-priced and low-priced products.

A complementary perspective related to price perception mechanisms is promoted by studies in the consumer neuroscience branch. A foundational study proposed by (Knutson et al. 2007) investigated the neural correlates of purchasing decisions by means of event-related functional magnetic resonance imaging (fMRI). Based on previous evidence of the existence of specific neural circuits related to anticipatory neural activations prior to decisions (Bechara et al. 1996; Kuhnen and Knutson 2005), (Knutson et al. 2007) demonstrated through a Save Holdings Or Purchase task that distinct neural activations may anticipate gains and losses and that prices perceived as disproportionate elicit specific subcortical regions prior to the purchase decision.

On a similar line of thought, (Berns and Moore 2011) employed fMRI to successfully predict novel songs' popularity evaluating brain responses at the subcortical level of the ventral striatum and nucleus accumbens. Empirical findings showed that average activations within the ventral striatum were significantly correlated with the actual units sold, suggesting that neurophysiological responses may hold predictive potential to anticipate purchase decisions. More recent attention has focused on the effect of changes in the price on the induced neural activity or and how such an activity results to be correlated with pleasantness ratings (Plassmann et al. 2008) or how price cues influence the experience of products (Schmidt et al. 2017). Furthermore, a contemporary stream of research in consumer neuroscience deals with the measurement and prediction of consumer unbiased willingness-to-pay (WTP) for products or services. Based on the analysis of the cortical activity through electroencephalography (EEG), Ramsøy et al. (2018) delve into localised asymmetric activations situated at the prefrontal region to ultimately assess that separate neuropsychological activations point to significant relationships with consumer WTP responses. Analogously, Herbes et al. (2015) show that it is possible to infer WTP to different green electricity products based on the measurement of the cortical electric activity.

Together these studies provide important insights into the possibility to gauge perceptive responses to price reduction schemes both through behavioural responses in terms of choice as well as from subject's neurophysiological activations. In line with the present conjecture, we assume that the existence of different price reduction perception mechanisms could lead to explicit effects both at a behavioural and a neurophysiological level. Such effects are expected to be closely linked to consciously or unconsciously value perceived by the consumer. More specifically, conscious value is expected to be derived in terms of self-reported intention to purchase. Whereas unconscious responses are expected to be related to neurophysiological activations or behavioural responses. Formally, our hypotheses are formulated as follows:

H1: For low-priced products, a relative price reduction is perceived as more valuable than the same price reduction framed in absolute terms;

H2: For high-priced products, an absolute price reduction is perceived as more valuable than the same price reduction framed in relative terms.

2. Coloured pricing schemes

A further significant factor closely linked to perceptive dynamics is found in colour. Colour is considered as a central element of marketing communications due to its influence on consumer perceptions and preferences (Babin, Hardesty, and Suter 2003; Singh 2006). In an experimental setting (Crowley 1993) showed how colour may affect the perceptive evaluation both in terms of arousal as well as valence. Activation-related affects (arousal) related to colour perception are a widely established phenomenon. Early studies have shown how some colours drive specific bodily activations or behavioural responses. Nakshian (1964) showed how the display of red could induce hand tremor more than green. In the same vein, Green et al. (1982) demonstrated how physical strength could be modulated by the display of either red or blue colours. Analysing the physiological activation, Gerard (1956) showed how the perception of red and blue influenced specific cortical activations in the low alpha EEG spectrum, pointing to higher activations induced by red. Analogous findings were displayed by Wilson (1966) who found red to be associated with higher dermoelectrical activations (on both absolute skin conductance measures and conductance change) than green. More recently Kido (2000) investigated the biopsychological effects of different colours on the bodily responses in terms of sympathetic activations and blood flow variations. Related findings point to lower electrodermal activations induced by colours such as purple or higher autonomic nervous system elicited by yellow. Collectively, these studies outline the modulating effects of colour on both perceptive and affective responses, where long wavelengths (related to 'warm' colours) are steadily associated with greater bodily activations.

In the pricing research stream, colour is often investigated as a modulating variable to emphasize specific price-related attributes (e.g. discounts) over other product attributes. For instance, empirical evidence shows that consumers tend to be more persuaded by coloured features in an advertising message rather than plain black and white (Meyers-Levy and Peracchio 1995). Previous research showed that colours may affect also the price-consciousness of the decision maker. Mandel and Johnson (2002) demonstrated how product evaluation may be skewed depending on the background colour employed in an online platform and how contexts depicted with long wavelength coulours such as red tend to lead people to opt for more expensive purchasing options. On a similar line of thought, building on the idea that coloured pricing schemes serve a heuristic function, Puccinelli et al. (2013) highlight how in low involvement conditions a price in red impacts perceived savings. More specifically, the authors report a that a price in red is related to greater perceived savings relative to black-coloured pricing displays and that such an effect appears significantly moderated by gender.

A portion of marketing studies investigating colour effects does not only focus on the extreme boundaries of the visual spectrum (i.e. violet or red), since the high and low end of the colour spectrum tend to drive polarised results (e.g. Wilson (1966) suggested that the high-end wavelengths related to red might be an elicitor associated to negative valence connotations such as danger). As a matter of example, Babin et al. (2003) analyse consumer reactions to colour variations of store interiors comparing orange and blue setting and point to greater patronage and purchase intentions related to blue interiors. The authors posit accordingly that orange colours are most associated with lower patronise intentions, being perceived related to higher savings.

The studies presented thus far provide evidence that colour schemes may effectively influence the perceptive responses to price reduction schemes. We assume accordingly that different coloured pricing schemes could lead to explicit effects both at a behavioural and a physiological level. In line with previous studies and theories (Babin et al. 2003; Hallock 2003; Puccinelli et al. 2013) we compare the effects of a long wavelength 'warm' colour, namely orange, with the colour representing the absorption of visible light, namely black. Consequently, our further hypotheses are reported as follows:

H3: Long-wavelength coloured price tags are perceived related to higher savings;
H4: Long-wavelength coloured price tags are perceived as arousing.

Research methodology

1. *Research design*

To test our hypotheses, we designed an experimental setting with two control variables, namely the price tag colour and the related promotion scheme. We adopted an experimental approach that combines physiological, behavioural, as well as self-reported measures. The combination of these three different data sources is expected to enrich the current multifactorial models investigating the perceptive mechanisms delving into the automatic responses, which take place with the absence of conscious forethought, as well as cognitive rationalisations.

Physiological measurements encompassed the tracking of cortical and cardiac responses of a subject, as indication of automatic bodily responses of desirability, attention, engagement and affect. These measures represent well established parameters considered by research in the consumer neuroscience field (Venkatraman et al. 2015) and rooted metrics related to the measurement of automatic bodily responses to visual stimuli (Lolatto et al. 2018; Reali et al. 2017). Behavioural responses included the analysis of the ocular search patterns employed by subjects. Ocular behaviours represent a cardinal activity in information processing and automatic responses (Glöckner and Herbold 2011; Meißner and Decker 2010), and therefore central to contribute to the discussion of hypotheses. Whereas self-reported measures collected through surveys were employed to assess the cognitive rationalisation of the information processing.

2. *Research protocol*

The study was conceived with a 2x2 between-subjects design with two factors corresponding to promotion scheme and price tag colour. Two distinct groups of subjects faced the same product with different discount information and different price tag colours. Specifically, discount information was presented either in relative or in absolute terms to the same reference price and two different colours of a stylized price tag were shown to different groups of subjects. Two product categories were selected as references for a high-priced and a cheap product, namely a blue t-shirt and a wooden table respectively. Both products were shown as digital images on a computer monitor as visual stimuli with no interactive features. No brands or iconic product design was associated with each stimulus in order not to introduce biased information. The two products were shown on a white background (RGB decimal code: 255,255,255) to avoid any confounding element of distraction, whereas their colour was chosen to be adequately dissimilar from the related price tag. Furthermore, the two objects were designed with comparable sizes in terms of screen coverage to circumvent any size-related bias. The t-shirt image covered 880x760 screen pixels, while the table resulted in a coverage of 880x740 pixels. Each product was associated with a single coloured two-dimensional price tag, sized comparably to previous research studies (Puccinelli et al. 2013) and with a screen coverage of 700x250 pixels. Two distinct colours, representing either a long wavelength 'warm' colour, namely orange (RGB: 255,165,0), or the absorption of visible light, namely black (RGB: 0,0,0). As concerns the discount information, the image of the table was associated with a price of €399 and a relative discount of either €80 or 20%, whereas the t-shirt was priced €25 and discounted of 5€ or 20%. A single text line was added in black (RGB: 0,0,0) above the stylised price tag indicating that the information reported in the price tag corresponded to the original price, whereas the discount scheme was reported below the price tag. No further element was included to avoid any visual bias. Examples of visual stimuli are reported in Appendix.

Each subject was exposed in a randomized order to the two neutral product categories. In order to provide comparable priming conditions, before the presentation of each stimulus the same product was shown on the screen devoid of pricing or promotional information for 10 seconds. To further minimize carryover effects, before and after the presentation of each product, a one-minute neutral video was presented to each subject to acquire baseline physiological levels at resting condition and to induce cooldown of physiological signals after the stimulus presentation. An initial one-minute baseline was employed to gather neurophysiological signals at resting conditions with eyes-closed subjects, to better highlight occipital alpha activations. The presentation of each stimulus lasted 15 seconds. We summarize the basic protocol in Figure 1.

Figure 1. Experimental protocol employed

3. *Experimental sample*

The study involved 80 subjects aged between 15 and 75 (M=37.2 SD=17.9), equally distributed by gender. The recruitment phase was carried out by an appointed provider to grant the exclusion of subjects with pacemakers or those diagnosed with cardiac or diabetic pathologies, on therapy with hypertension drugs, with a history of epilepsy, acute visual problems, frequent migraines, headaches or colour blindness. Prior to the beginning of each experimental session, a laboratory assistant briefed participants about the objective of the study and informed written consent was obtained before any data collection. Each experimental session was carried out in a neutral experimental setting devoid of elements of distractions, with the participant observed at an adequate distance to bound any sort of contact. Each visual stimulus was presented on a 24’’ screen, in full-screen mode and screen brightness was kept constant during each session. Participants were provided with monetary compensation for participation at the completion of the experimental session.

4. *Instrumentation*

During each experimental session, three different biosignals were acquired, namely (i) the subject’s cortical activity by means of an electroencephalogram (EEG), (ii) her cardiac activity by means of a single electrocardiogram (ECG) lead, (iii) and her ocular activity through eye-tracking technology. All the signals were continuously recorded during the experimental phases. The EEG signal was acquired by means of a portable system equipped with a 64-channels pre-cabled cap, where 27 electrodes uniformly distributed on the scalp were activated. A standard 10–20 configuration was employed with electrodes prepared with a water-based gel to enhance the electrical conductivity between each electrode and the subject’s scalp (Kappenman and Luck 2010). The cortical activity was collected at a sampling rate of 256 Hz and the impedance level was kept below 5 kΩ. The single ECG lead was acquired by means of ProComp Infiniti unit from Thought Technologies through three electrodes placed according to Einthoven's triangle. The signal was recorded at a sampling rate of 256 Hz. The eye-tracking signal was gathered through a remote eye-tracking bar attached to the computer monitor, recording at a sampling rate of 60 Hz. To assure a sound signal recording, subjects were seated at a distance ranging from 60 to 75 centimeters from the eye-tracking bar.

5. *Measures*

The acquired physiological data acquired were firstly preprocessed. Raw data were firstly inspected through eye-balling after an initial band pass filtering (high pass = 1 Hz; low pass = 35 Hz) to clean from movement artefacts and signal noise. Secondly, muscular and ocular artefacts were identified and removed from the EEG signal through independent component analysis (ICA). Signal traces with deletions of more than 5 seconds out of 15, were discarded as considered highly noisy. A referencing process was then performed on the original EEG signal to refer to a specific electrode placed on the pre-cabled cap, namely between the CPz and Pz EEG channels. Subsequently the signal was transformed by means of Common Average Reference (CAR) in order to compute an Attention Index (AI) through the occipital alpha activations a Desirability Index (DI) from the hemispheric asymmetries in frontal cortical activity as suggested in previous literature (Coan and Allen 2004; Sutton and Davidson 1997; Vecchiato et al. 2011). Each subject's Individual Alpha Frequency (IAF) was then processed from the physiological responses at baseline level according to (Klimesch 1999). Lastly, EEG traces were band pass filtered to obtain four different signals, encompassing different contributions of the EEG spectrum, namely (i) theta, which ranges between IAF–6Hz and IAF–4Hz; (ii) lower alpha, between IAF–4Hz and IAF, (iii) upper alpha, between IAF and IAF+2Hz, and (iv) beta, between IAF+2Hz and 22 Hz. The Attention Index (AI) was assessed by computing Global Field Power (GFP) considering the lower alpha frequency band for the channels Fpz, AF3, F3, AF4, F4, Fz. Similarly, the upper alpha band pass filtered channels F3, AF3, F4, AF4 were used instead to compute the Desirability Index (DI). Moreover, a cognitive Engagement Index (EI) was computed as the ratio between spectral power in beta and alpha bands (Coelli et al. 2018). Each individual value was standardized in reference to the subject's physiological baseline to allow between subject's comparisons.

The raw cardiac activity was initially preprocessed through eye-balling to detect signal artefacts due to external noise. Subsequently the mean heart rate during the overall stimulus exposure was calculated and employed as measure of Affect (Colomer Granero et al. 2016). Lastly, the eye tracking signal was processed to detect the ocular responses related to three specific areas of interests (AOI), namely product features, price tag and discount information. AOIs were trimmed considering only the product contour lines, excluding white spaces. Behavioural metrics were automatically calculated from a designated software (SMI BeGaze, version 3.7) and employed as indicators of visual attention and their importance to the participant. The employed metrics were calculated on each of the three AOIs and included the (i) observational dwell time, as the sum of fixations and saccades times within an AOI, (ii) the number of revisits as the number of fixation returns within an AOI, and (iii) the ocular entry time, computed as the time required to the subject to perform the first fixation in the specific AOI measured in milliseconds.

Lastly, self-reported measures of perceived attention, engagement and pleasure as well as perceived affect and intention to purchase were adapted from previous literature (Mehrabian and Russell 1974; Puccinelli et al. 2013) and gathered through 7-points likert scales by means of an online survey administered after each stimulus. A further self-reported control variable was introduced to gauge potential interest towards the displayed item.

Results

Neurophysiological, behavioural as well as self-reported data were analysed by means of a 2×2 between-subjects analysis of variance (ANOVA), with fixed factors corresponding to discount scheme (absolute or relative) and price tag colour (orange or black). Eye tracking data revealed a consistent pattern related to the two factors interaction. Ocular dwell time on the price tag AOI resulted significantly influenced by the interaction between price tag colour and relative discount scheme for the low-priced product ($F(1,76) = 6.101$, $p = .015$). An exploration of the nature of such interaction showed that an orange price tag associated with a percentage discount scheme led to significantly greater dwell time ($M_{o,\%} = 4043.6$ ms) than all the other discount scheme and price tag colour combinations ($M_{o,\Delta} = 2166.1$ ms; $M_{b,\Delta} = 1954.8$ ms; $M_{b,\%} = 2028.1$ ms see Figure 2). A comparable pattern was evidenced concerning the number of revisits on the price tag AOI ($F(1,76) = 7.057$, $p = .009$), where the orange price tag with relative discount resulted in a higher number of revisits ($M_{o,\%} = 4.75$) in contrast to all the other discount scheme and price tag colour combinations ($M_{o,\Delta} = 0.67$; $M_{b,\Delta} = 0.44$; $M_{b,\%} = 0.53$ see Figure 3).

A significant effect was further attributable to the colour factor, where the overall orange price tag was linked to a higher dwell time ($F(1,76) = 9.295$, $p = .003$) and number of revisits on the price tag AOI (F (1,76) = 10.341, p = .002) than overall black price tag. No analogous results related the ocular activity were associated with the high-priced product. Table 1 and Table 2 display ANOVA results showing the effects of main predictors and their interactions on the dependent variables extracted from eye tracking data. Whereas in Figure 4 and Figure 5 are reported the main effects related to the colour factor for both products.

Dependent variable	Dwell time			Revisits			Entry time		
	df	*F*	Sign.	*df*	*F*	Sign.	*df*	*F*	Sign.
Main effects									
Colour	1	9.295	.003	1	10.341	.002	1	2.990	.086
Price reduction scheme	1	7.133	.008	1	7.202	.008	1	1.403	.238
Two-way interaction									
Price x Colour	1	6.101	.015	1	7.057	.009	1	2.181	.142

Table 1. Analysis of variance results for eye tracking metrics on price tag AOI for low-priced product

Dependent variable	Dwell time			Revisits			Entry time		
	df	*F*	Sign.	*df*	*F*	Sign.	*df*	*F*	Sign.
Main effects									
Colour	1	3.909	.056	1	9.502	.004	1	0.222	.640
Price reduction scheme	1	0.119	.732	1	7.313	.010	1	0.088	.769
Two-way interaction									
Price x Colour	1	0.699	.409	1	4.249	.047	1	0.003	.959

Table 2. Analysis of variance results for eye tracking metrics on discount AOI for low-priced product

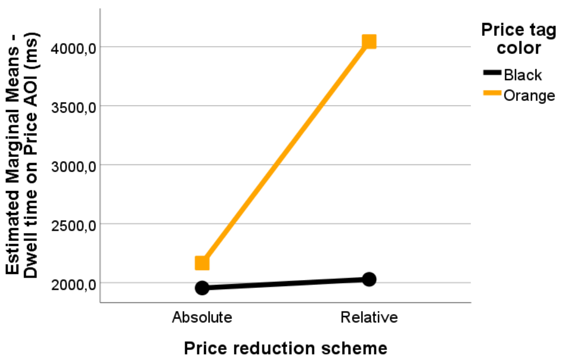

Figure 2. Interaction effects of price reduction and colour scheme on ocular dwell time for low-priced product

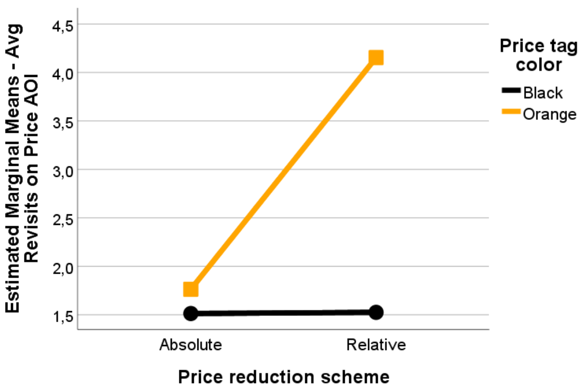

Figure 3. Interaction effects of price reduction and colour scheme on number of revisits for low-priced product

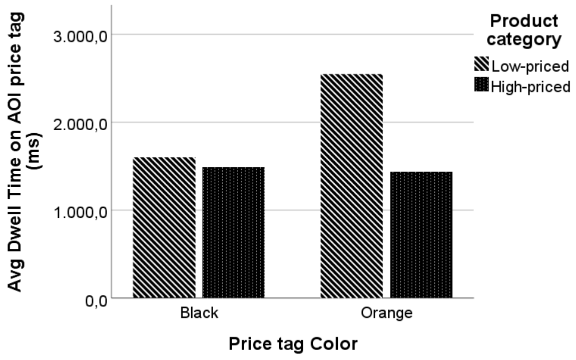

Figure 4. Effect of price tag colour on ocular dwell time

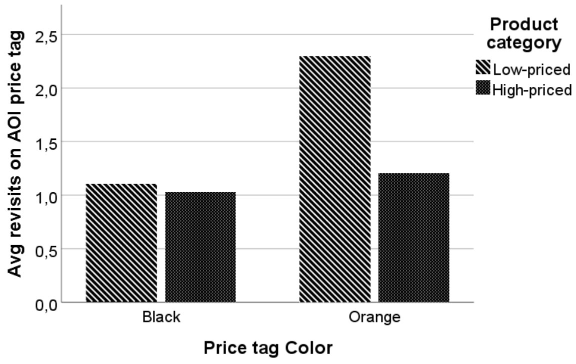

Figure 5. Effect of price tag colour on number of revisits

A consonant analysis on the self-reported data evidenced a higher perceived positive affect related the low-priced product discounted in relative terms (F (1,79) = 4.489, p = .037), where a relative price reduction scheme was associated to a higher positive affect (M = 4.71, SD = 1.58) than an absolute price reduction scheme (M = 4.02, SD = 1.29). Differently, between-subjects ANOVAs on the high-priced product revealed a significant interaction between the two factors (F (1,76) = 4.654, p = .034), where the black price tag with relative discount resulted in a high affect ($M_{b,\Delta}$ = 4.80) as the combination of black coloured price tag and relative discount ($M_{o,\%}$ = 4.73) as reported in Figure 6. Table 3 shows ANOVA results for self-reported affect on both product categories.

Dependent variable	Low-priced product Self-reported affect			High-priced product Self-reported affect		
	df	*F*	Sign.	*df*	*F*	Sign.
Main effects						
Colour	1	1.044	.310	1	0.079	.780
Price reduction scheme	1	4.489	.037	1	0.002	.965
Two-way interaction						
Price x Colour	1	0.313	.578	1	4.654	.034

Table 3. Analysis of variance results for self-reported affect

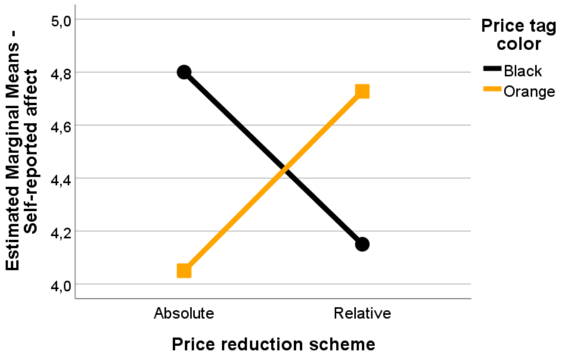

Figure 6. Interaction effects of price reduction and colour scheme on self-reported affect for high-priced product

Cortical activations pointed to a significant differential activity in terms of prefrontal alpha asymmetries correlated to the low-priced product when shown with different coloured price tags (F (1,69) = 5.239, p = .025). Specifically the related Desirability Index reported higher values (i.e. higher pre-frontal activations in the left brain hemisphere) for black price tags in the low-priced product (M = 0.502; SD = 0.028) rather than when exposed to orange coloured price tags (M = 0.486; SD = 0.031), as reported in Figure 7). Lastly, as concerns the high-priced product, the exposure to the orange price tag in conjunction with a relative discount scheme led to a significant increase in the subject's heart rate (F (1,66) = 5.419, p = .023. See Figure 8). No significant effect was related to gender, age or product interest. An overall summary of the experimental results related to previous hypotheses is reported in Table 4.

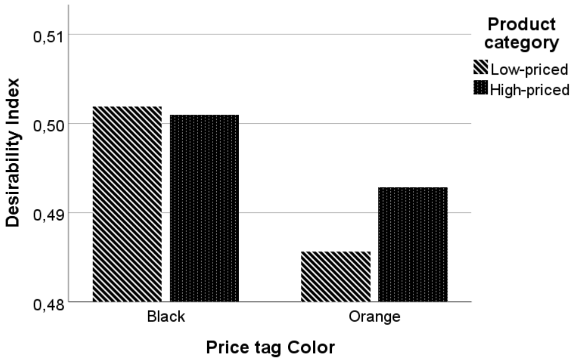

Figure 7. Effect of price tag colour on Desirability Index

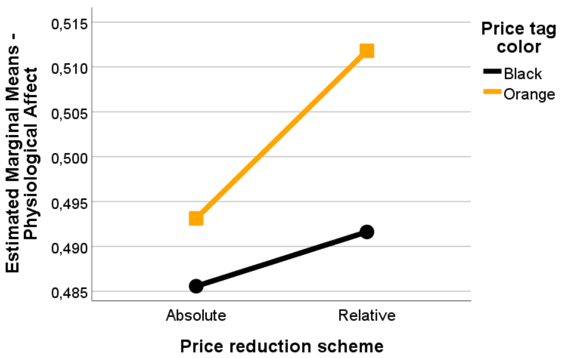

Figure 8. Interaction effects of price reduction and colour scheme on physiological affect for high-priced product

Hypothesis	Formulation	Experimental evidence
H1	For low-priced products, a relative price reduction is perceived as more valuable than the same price reduction framed in absolute terms	Supported
H2	For high-priced products, an absolute price reduction is perceived as more valuable than the same price reduction framed in relative terms	Partially supported
H3	Long wavelength coloured price tags are perceived related to higher savings	Supported
H4	Long wavelength coloured price tags are perceived as more arousing	Supported

Table 4. Results of hypothesis testing

Discussion

This study set out with the aim of exploring the influence of price reduction schemes and price tag colour on the perceptive mechanism of a decision maker through consumer neuroscience methods. Experimental results provide different elements of interest. Firstly, self-reported evaluations corroborate earlier findings concerning the perceptive effectiveness of a price reduction scheme framed in relative terms for a low-priced product (Chen et al. 1998; DelVecchio et al. 2007). Building on this established outcome, the analysis of the ocular activity point to a robust influence of the interaction with the colour scheme. We demonstrate how the combination of an orange price tag and a percentage-off price reduction tend to attract the ocular attention of the viewer for longer time spans and induce higher returning rates. We conjecture that, given the constrained time interval available to each subject, higher visual interaction with the price tag may indicate higher visual engagement. A possible explanation for this result may lay in the chromatic salience of the orange price tag when compared to black labels. Indeed, previous experimental evidence shows how warm colours tend to be more eye-catching relative to cool and neutral colours (Lee, Choi, and Suk 2013). Taken together, these first results provide full support for our H1 hypothesis.

Different results were observed concerning the high-priced product. The single dimensions of price tag colour and discount schemes result not to be influential on the ocular and self-reported responses. However, the two factors interaction point to significant effects on self-reported affect. Namely, pricing a high-priced item either with a black tag associated to euro-off discount or with an orange price tag with percentage-off discount may signal greater perceived savings. These results provide only partial support to our H2, signaling a moderating impact of colour on perception.

The analysis of reward-related cortical activations during the visual stimuli exposure pointed to a further notable result. Experienced desirability, intended as an attraction towards a specific stimulus (Coan and Allen 2004; Davidson 2004), appeared to be modulated by price tag colour and not by the displayed discount scheme. Specifically, our findings show how black-priced labels affected positively the observer across the two product categories. To the best of our knowledge, this result provides an opening evidence in support of previous marketing theories on pricing perception based on self-reported assessing that long wavelengths colours (i.e. ‘warm’ colours) tend to be perceived as cheaper than other colour schemes. Conversely, pricing colour schemes adopting short wavelengths colours tend to foster association with pricy items (Hallock 2003; Puccinelli et al. 2013). Given the common direct inference of a direct relationship between the price and product quality (Cronley et al. 2005; Kardes et al. 2004), we could deduce a link between such higher perceived product quality at a perceptive level and the greater experienced desirability at a cortical level.

A note of caution is due here since the possible interference of different colours on basal neural activity cannot be ruled out. However, results show a consistent pattern only across the hemispheric asymmetries in frontal cortical activity (i.e. Desirability Index) and not across other cortical metrics (i.e. Attention Index and Engagement Index), precluding any structural bias in the cortical metrics. Taken these considerations together, it could conceivably be hypothesised that black coloured price tag lead to a higher sense of approachability potentially due to a higher perceived sense of product preciousness. It can thus be suggested that our experimental results provide support for H3.

Lastly, our findings point to an additional support of previous findings relating to affect-related effects of colour. Though significantly evidenced only on the high-priced product, we observed an effect on the cardiac responses modulated by the orange colour. In particular we found how orange coloured price tag elicit higher heart rate, pointing to a greater arousing effect of long wavelengths colours, supporting evidence from previous observations (Crowley 1993). This result suggests a further support for our H4.

Research and managerial implications

This research attests the idea that the combination of colour and promotional schemes fosters a heuristic function influencing perceptive and affective responses. Through an experimental study involving physiological, behavioural, as well as self-reported measures we suggest that different measures may provide complementary insights in support of pricing strategies both to pricing perception theory and practice. Concerning the theoretical contribution, the present results stress the fact that price tag colour schemes may impact on the product desirability, assessed from cortical responses. Such an outcome points to the possibility of gathering specific insights related to product perception directly from the autonomous nervous system, thus inferring responses from a potentially unconscious layer. Despite being primal results, future research both in marketing and cognitive psychology may benefit from the possibility to infer desirability induced by coloured stimuli. Secondly, our findings confirm the arousing role of long-wavelenghts colour. Differing from most of prior research which focus on the extreme end of the visual spectrum analysing red (Mandel and Johnson 2002; Puccinelli et al. 2013), the present results point to similar physiologically arousing effects elicited by orange stimuli. This result appears in line with conceptual theory and constitute a sound empirical proof.

To enhance product offerings' effectiveness and strengthen the design process of product offering in practice, we suggest firstly to discriminate according to the product price category. On the basis of our tested factors, low-priced products appear to be perceived more attractive when associated with orange coloured price tag in conjunction with a discount framed as percentage-off. Orange labels result to be more eye-catching, thus leading to a potential higher visual engagement. The orange colour may further elicit higher affective physiological responses, an established component and trigger of impulse buying behaviours (Beatty and Ferrell 1998; Piron 1991). Furthermore, at a cognitive level a percentage-off framed discount emerges to be positively evaluated and signal greater perceived savings.

On the other hand, our findings show that labelling high-priced products with black coloured price tags in conjunction with a discount scheme presented in absolute terms may result more suited. Euro-off black coloured framed discounts turn out to be perceived as more valuable in terms of perceived affect. At the same time black coloured price tags may play a role at the automatic processing level, eliciting higher product desirability and create a perception of higher product quality and preciousness.

Limitations and future research

The generalisability of the discussed results might be subject to certain limitations. In particular, two sources of weakness could have affected the measurements: on the one hand limitations are related to the characteristics of the experimental group, on the other hand constraints may be related to the chosen stimuli. As concerns the experimental group, we did acknowledge low self-reported interest in buying both products, pointing to a low-involvement towards the displayed products (i.e. blue t-shirt and wooden table). The participation of highly-involved subjects towards a displayed product may hence provide different results. Secondly, the chosen stimuli included only a bounded set of prices and colour patterns. In such a direction, a higher spectrum of prices (e.g. involving luxury products) or colours may provide a more complete view. A natural progression of this work will be to analyse different colour patterns as well as enlarging the product categories to delve into influential features such a product functionalism or hedonism.

Appendix

Example of low-priced product visual stimuli

Example of high-priced product visual stimuli

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