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NEW INSIGHTS INTO THE IMPACT OF DIGITAL SIGNAGE AS A RETAIL ATMOSPHERIC TOOL

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Keywords Shopping environment; mall; digital signage; digital communications network; plasma screen; LCD screen; retail atmospherics.

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ABSTRACT

This paper investigates the previously little-researched role of digital signage (DS) in retail atmospherics, using an environmental psychology framework, drawing support from the Limited Capacity Model of Mediated Message Processing (LCM). DS consists of screen displays in public spaces showing video. The method consisted of a structured questionnaires quasi-experiment (n=357), comparing before and after DS installation against an unchanged control mall. Results demonstrate the effectiveness of DS, which has a positive effect on shoppers' approach behaviours such as spending, mediated by perceptions of the retail environment and positive affect.

Results are limited as the DS screens content was information-based, whereas according to LCM, people pay more attention to emotion-eliciting communications. The results have practical implications as digital signage appeals to employed shoppers. This study contributes to

theory by providing a rare longitudinal environmental psychology study of the effects of an atmospheric stimulus on real shoppers in a real retail context.

Keywords Shopping environment; mall; digital signage; digital communications network; plasma screen; LCD screen; retail atmospherics.

INTRODUCTION

The retail landscape is changing rapidly. In the UK, for example, traditional high street spending is stagnant or even falling (BRC, 2011); with famous brand names struggling to survive (Sunday Times Business, 18 December, 2011) whilst e-shopping continues double digit growth (IMRG, 2011) from currently 14 percent of non-food sales predicted to reach 34 percent by 2020 (Javelin, 2011). At the same time, offline and online channels are becoming increasingly inter-related, with shoppers, for example, researching in store and buying online (Javelin, 2011), which can be aided by a smartphone price comparison app allowing shoppers to scan a barcode (Carmody, 2010). Major retailers are increasingly providing shopping assistant systems for consumers, either *via* shopping trolleys or apps on consumers' own smartphones (Pantano and Naccarato, 2010). These apps are catching on with consumers, with around one-sixth of the US and European consumers who use location-aware smartphones using them for location-based shopping or coupons (Microsoft, 2011). Thus, there is pressure on traditional retailers to improve efficiency, often by the use of technology (Pantano, 2010; Pantano and Timmermans, 2011) and to improve the shopping experience (Pantano and Naccarato, 2010).

This study concerns a technology development with the potential to improve the retail experience: digital signage or digital communications network (DCN). The study evaluates the impact of digital signage on shoppers' perception of the retail environment, positive affect, and approach behaviour in a shopping mall context. Digital signage consists of 'screen displays located in public spaces showing video material (or private TV channels)' (Clarke, 2003), Content typically includes (e.g.) advertisements, community information, entertainment and news. TV screens have been used in retail environments for some time but since the advent of digital control and flat screens, the use of networks of screens has made digital signage available as an effective, easily controlled communication medium. Referring to digital billboards, the Outdoor Advertising Association of America describes them as: ' … updated electronically through a variety of methods. Some are networked together, most are operated remotely, and all of them can be updated quickly, sometimes with just the click of a mouse. This ability gives digital [signage] flexibility and nimbleness. This nimbleness gives local businesses a unique and powerful way to reach a large number of geographically targeted consumers very quickly' (Outdoor Advertising Association of America, 2009).

Digital signage content may include, for example, advertisements, community information, entertainment and news. Such screen networks go by many names but we use the terminology 'digital signage' here as being most commonly used internationally. Similarly, we use 'shopping mall' (or simply 'mall') as the term becoming more accepted internationally for what has formerly been referred to in some retail literature as a 'shopping centre', i.e. a 'planned retail development … managed and marketed as a unit' with a 'pedestrian precinct covered from the weather' (Dennis, 2005, quoting Guy, 1994 and citing Reynolds, 1993).

Digital signage aims to talk to shoppers while they are captive and in the mood to buy. Retailers in countries including the US (Albertson's, Target, Kroger), the UK (Tesco, Asda, Sainsbury) and China (Carrefour) have launched digital signage networks. In addition to pushing merchandise, digital signage also generates hefty advertising revenues. Brand manufacturers pay anywhere from to $60,000 to $293,000 for a four-week campaign on Wal-Mart's TV network connecting more than 2,500 stores (The Economist, 2006). Although research figures are sparse, industry insiders estimate that digital signage is currently worth around $2billion in the US (Computerworld.com 2007).

Digital signage might be considered as contributing to retail atmospherics. Leo J. Shapiro & Associates, the firm that conducts store atmospherics surveys for *Chain Store Age* (Wilson, 2005) categorises in-store TV among interactive atmospheric elements helping retailers building a competitive advantage. Research indicates that shoppers tend to consider that they would benefit from technological innovations such as electronic shelf-edge displays (a special case of digital signage) and product information kiosks (which parallel digital signage) (Burke, 2002).

This paper examines the effect of a digital signage network in contributing to retail atmospherics by influencing shoppers' perceptions of the overall retail environment and approach/avoidance responses. The research takes place in a shopping mall environment which differs from the retail store in not being aimed primarily at promoting a single retailer. Rather, digital signage in the mall environment is similar to the outdoor digital billboard, where it is often used to display breaking news, community information and promote a range of local retailers (Outdoor Advertising Association of America, 2009). As outlined by Underhill (2004), the mall is a store of stores, and better provision of information and perceptions of the

atmosphere and environment of a mall should enhance shoppers' experiences such that they are likely to stay longer and spend more money (Wright et al., 2006).

Digital signage is thus an important tool for retail atmospherics, with particularly important potential for shopping malls. Yet, there is a paucity of scholarly research into digital signage (for exceptions, see Dennis et al., 2010; Newman et al., 2006) and previous studies (Grewal et al., 2011; Kalyanam et al., 2010) highlight the need for further research in this area. This study therefore sets out to address this research gap. The paper aims to make a theory contribution by exploring processes by which digital signage influences perception of a mall environment, affect and approach/avoidance behaviours. There are important implications for mall owners and for retailers, as, if digital signage can be demonstrated to enhance perceptions of a mall environment, research demonstrates that shoppers transfer perceptions of the mall environment to the store images of individual retailers (Chebat et al., 2006), which may significantly impact revenue.

CONCEPTUAL FRAMEWORK

The Shopping Mall

Consumers patronise shopping malls for purposes other than mere convenience (Woodruffe-Burton et al., 2002). Shopping frequency in malls is correlated with deal proneness, recreation and demographic characteristics (Roy, 1994). Personal life values and ethnic identification also influence mall patronage (Shim and Eastlick, 1998). Shoppers patronise shopping malls for walking and exercise (Hangland and Cimbalo, 1997) and as a social and recreation meeting place (Graham, 1988). The shopping mall is considered as a public place for community development

among non-shoppers (Lewis, 1990), for the construction of social links (Aubert-Gamet and Cova, 1999), a city within a city (Backes, 1997) and as an ecological habitat for consumers (Bloch et al., 1994).

Many traditional shopping malls have difficulty competing against newer shopping malls that target fashion-oriented, value-oriented or time constrained shoppers (Reynolds et al., 2002). Mall image, ease of spatial navigation (way finding), and entertainment stimulate shoppers' visits. The importance of the physical environment in a retail store setting has long been recognised (Baker et al., 2002; Bitner, 1990; Bitner, 1992; Bloemer and De Ruyter, 1998; Theodoridis and Chatzipanagiotou, 2009) and has more recently been extended to that of the shopping mall (e.g. Chebat and Morrin, 2007).

Retail Atmospherics

Retail atmospheric stimuli should be recognisable by consumers' senses, lead to positive shopping behaviour and be capable of being effectively manipulated by retailers (Turley and Chebat, 2002).

Reviews of many prior studies (Bakamitsos and Siomkos, 2004; Turley and Milliman, 2000) underscore a wide spectrum of shopping behaviours that can be influenced by specific atmospheric stimuli in a variety of retail formats. A selection of these and more recent studies is included in Table 1. Atmospheric stimuli that have been demonstrated to positively affect patronage behaviours include music (Garlin and Owen, 2006), lighting (Summers and Hebert, 2001), colour (Babin et al., 2003), design (Sherman et al., 1997) and digital signage (Dennis et al., 2010). Comments on selected studies follow in the sections below.

[Take in Table 1 here]

Mall Atmospherics

Compared with store atmospherics, there are fewer studies about how consumers perceive or respond to a mall's environment, particularly with respect to specific stimuli (Table 1). The limited research available indicates that, similarly to stores, mall atmospherics influence mall image, shopper affect (e.g. Wakefield and Baker, 1998) and patronage (e.g. Finn and Louvière, 1996). Interestingly, mall image influences store image (Chebat et al., 2006).

We predict that mall atmospherics will not only contribute to building mall traffic, but also promote sales and additional spending. Based on the environmental psychology approach (Foxall and Soriano, 2005; McGoldrick and Pieros, 1998; Mehrabian and Russell, 1974), a shopping-congruent atmosphere is expected to put shoppers in a favorable mood, have them stay longer in the mall, and encourage them to spend more.

Digital signage

As a relative newcomer to the retail environment, digital signage networks are now found in the marketing toolbox. Digital signage networks are used in many retail contexts, including main street shopping areas, malls and individual stores. Most commonly they consist of flat LCD or plasma screens with content linked digitally. They are used for many purposes, including advertising; provision of news and community information; and to enhance image. In the outdoor arena, screens can be very large, matching the largest conventional billboards. In most retail applications size is more modest, often less than two meters, although some can be much larger

digital billboards. Shopping malls use digital signage particularly to generate advertising revenue (which is important but beyond the scope of this study); and to improve customer satisfaction and image.

We are able to cite only two published papers on the marketing aspects of digital signage in scholarly journals. First, a qualitative study by Newman et al. (2006) reports on the acceptability of digital signage to shoppers. That paper reports the results of eight focus groups (51 participants in total) with shoppers of varying age and gender recruited in a mall in which digital signage had just been installed. The consensus was that the digital signage created an ambience that influenced participants' perceptions of the mall environment, giving it a more modern image. The participants reported that the screens added enjoyment to their shopping experiences and provided useful information, informing their shopping choices. There were few objections to the digital signage but a minority of the participants considered it to be boring and not attention-grabbing. Second, Dennis et al. (2010) report a survey of mall consumers (n = 315). That study suggests that digital signage has a significant, positive, total effect on approach behaviours such as consumer spending, mediated by positive affect and (arguably) perception of the mall environment, although as a cross-section study rather than an experiment, the reported effects of digital signage must be treated with caution.

The impact of digital signage on shoppers' perception of the environment and shoppers' responses falls in general within the environmental psychology approach (McGoldrick and Pieros, 1998; Mehrabian and Russell, 1974) and, more specifically to the digital signage stimulus, the Limited Capacity Model of Mediated Message Processing (LCM), which models how people process television communications, predicting the effectiveness of vivid moving visual images (Lang, 2000). The LCM (Lang, 2000) holds that people have a limited capacity to

process information and therefore allocate processing resources to those most demanding stimuli that have a high information rate and distinctive features such as movement, colour and vividness (Li and Bukovac, 1999). Digital signage should therefore act as a more effective atmospheric stimulus, with higher recall of messages than those that are static or less vivid (Taylor and Thompson, 1982). Moving images attract viewers' attention (Reeves and Nass, 1996). The findings of Newman et al. (2006), mentioned above, that few people object to digital signage and most perceive it positively support the LCM in this context. We therefore consider that digital signage will constitute an effective marketer-manipulable atmospheric stimulus.

RESEARCH HYPOTHESES

There is ample evidence summarised above and in Table 1 to confirm that various environmental stimuli induce emotions that in turn influence approach/avoidance behaviour. There is limited research on the effect of digital signage specifically but as the LCM predicts that people pay more attention to emotion-eliciting communications, we expect that any emotion-eliciting content on the digital signage screens is likely to have positive effects, helping to justify our use of an environmental psychology framework.

According to the principle of cognitive mediation, the effects of cues (such as atmospherics) on people's emotions and behavioural responses are initially mediated by cognition (Lazarus, 1991). We propose that the cognitive construct of perception of the mall environment mediates the effects of the stimulus-emotion links (Chebat and Michon, 2003). According to the LCM (Lang, 2000), the moving images of digital signage should constitute an effective atmospheric stimulus that may influence shoppers' images of the shopping environment, for example providing information. Therefore, following the LCM:

H_1 *Digital signage providing information to shoppers will positively influence perceptions of a mall's environment.*

The environmental psychology approach has been previously tested in a retail setting. The perception of a pleasant shopping environment (Dubé and Morin, 2001) should elicit positive emotions such as pleasure and arousal (Ang et al., 1997) and result in higher spending (Spies et al., 1997). Our model also draws on cognitive mediation (Lazarus, 1991) in that the specific stimulus (digital signage) influences the cognitive perception of other attributes of the mall environment which then influence affect and in turn influence behaviour. This mediation has been found to hold in retail atmospheric studies. For example, Sherman et al. (1997) find that the retail environment influences shopping behaviour but this influence is mediated by pleasure and arousal. In a more specific parallel, Chebat and Michon (2003) find that the influence of ambient aroma on shopper spending is mediated first by the cognitive perception of a store environment, then also by pleasure and arousal. In both the theory of cognitive mediation and the empirical results of Chebat and Michon (2003), mediation is full rather than partial. Following the principle of cognitive mediation and in analogy with the aroma stimulus, we therefore predict that:

H_2 *The effect of digital signage on shoppers' affect will be fully mediated by the perception of the mall environment.*

Research propositions are summarised in Figure 1.

[Take in Figure 1 here]

Digital signage is a relatively new, technological innovation. Therefore, in line with Rogers's (1995) Diffusion of Innovations, we expect age and income-earning status to have a moderating effect, such that digital signage has a greater positive impact for shoppers who are younger and earning, *vs.* those who may be retired or on state benefits.

The hypotheses above are based on the principle of cognitive mediation (Lazarus, 1991), in that the specific stimulus (digital signage) influences the perception of other attributes of the store environment which then influence emotions and in turn influence behaviour. This is the cognition → emotion model. Notwithstanding this, an alternative argument holds that atmospheric stimuli influence emotion (Donovan and Rossiter, 1982) and that emotion influences cognitive perceptions (Zajonc and Markus, 1984). In line with this, Puccinelli (2006) finds that people who are in a good mood before shopping have a better perception of products that they see and are willing to spend more, i.e. the emotion → cognition model. In the case of the digital signage stimulus, the two competing approaches are not necessarily mutually exclusive but are both consistent with the Elaboration Likelihood Model (ELM) of Petty and Cacioppo (1986). The message appeal can be either rational or emotional. The rational appeal may be more effective when the elaboration likelihood of the communication situation is high, i.e. when shoppers' processing resources are unrestricted and they can stop to watch the digital signage and perceive specific information (notwithstanding that customers may still process information *via* the peripheral route, particularly if they have not perceived relevance). Under high elaboration likelihood conditions, a person's cognitive responses will determine the

behavioural outcome – the 'central route' – and these cognitive responses may result in controlled, higher-order Type III affective appraisals of the stimulus (Cohen and Areni, 1991; Pham, 2004; Shiv and Fedorikhin, 1999). Alternatively, when the elaboration likelihood is low, i.e. when shoppers' processing resources are restricted and the digital signage is perceived as background 'wallpaper', shoppers will not process messages cognitively but may still be influenced emotionally – the 'peripheral route' – and this affect, either Type I that is based on triggering hardwired programs and conceptually similar to the affect that Zajonc (1980) detected in his studies on "mere-exposure" effect or Type II that is based on the activation of emotional schemas and acquired through conditioning (Cohen and Areni, 1991), may still positively influence approach behaviour. Therefore, digital signage content might usefully be designed specifically to increase positive emotions. In this study, the researchers had no influence on the content, which was mundane and information based (as detailed in the 'Method' section below), and no control over shoppers' processing resources. However, there was no reason to believe that shoppers' processing capacity was consistently reduced on average. Therefore, we would expect that, in this instance, the model in which cognition gives rise to a higher-order affect would be superior to the model in which a low-order affect precedes cognition. Notwithstanding our hypothesised direction, when analyzing the findings, we acknowledge that our method is unlikely to resolve the direction conclusively and consequently examine both models.

METHOD

Research Setting

The quasi-experimental research concerns two similar-sized and comparable shopping malls in West London (UK), one being used as control. It was carried out in two phases, before

and after the introduction of a digital signage network in the mall under study. The first phase was carried out immediately before the installation of the digital signage followed by the second phase, which was held off until six months later in order for the effects of the installation of the digital signage to have stabilised. The role of the control mall was to neutralise the effects of other exogenous variables such as seasonality and validate measurement changes attributable to the introduction of digital signage. Changes in the test mall were compared against the control mall. This method improves validity by overcoming the potential flaw of standard "before and after" longitudinal studies – possible changes in uncontrollable confounding conditions. With this quasi-experimental design, incremental changes in perceptions are measured more precisely by comparison with the control mall (Cook and Campbell, 1979). No observable environmental changes, marketing communications or public relations activity took place at the control mall (or at the test mall, other than the installation of the digital signage) during the period.

The digital signage consisted of nineteen 1.07-metre plasma screens distributed around the public areas of the mall including the café (but not particularly placed at the entrances to the mall and not in the retail stores). The content consisted of one-third community information such as what was on at the theatre; one-quarter news, weather and sport; one-quarter advertising for the mall as a whole; and one-sixth local advertising. There was no entertainment other than in those categories, no national advertising and no sound.

Our sample consisted of actual customers that patronize both malls. In order to ensure that the sample was as representative as practicable of local people who may shop frequently or otherwise at the malls, it was sourced in two ways: post and email (eschewing mall intercept as less suitable for a long questionnaire (Frost-Norton, 2005)). The postal sample was intended to be representative of the residents in the area, obtained as a random selection from a

commercially-available permission-based list sourced from the register of electors, selecting residents' living within 6 miles of the test mall (1000 before and 1000 after). The email sample was sourced from a commercially-available consumer panel who have given permission to be emailed with surveys and offers, again selecting residents living within 6 miles of the test mall. The email sample reflected the slightly higher-than-average socio-economic profile of the typical mall shopper (1000 before and 1000 after).

Noting that McGoldrick and Pieros (1998) demonstrate shortcomings of previous retail atmospherics studies that use student samples, in order to maintain the integrity of our non-student shopper sample, any responses self-classified as 'student' were not considered in the analysis of results. Participants were offered a chance to win a shopping voucher worth £100 as an incentive to respond within five days. The response rates varied between 6.7 percent and 11.7 percent and responses totaled 357 usable questionnaires (see Table 2a). Seventy-six percent of the responses were received back within three days of the first response arriving. We therefore consider responses of four days and over to be late responders. The means of all the main variables for the late responders do not differ significantly from the means of those variables for the non-late responders; hence we conclude that there is likely little non-response bias in our model.

The sample achieved a profile approximately matching that of a typical upper socio-economic suburban mall with 68 percent females (the mall owner's figure from proprietary data is 73 percent), median age of 44 years (same as mall owner's figure), 77 percent actively income-earning (not recorded in mall owner's data), 76 percent of households in the higher socio-economic employment categories (mall owner's figure 74 percent) and a median household income of £35,000 (not recorded in mall owner's data). There were no significant

differences between the "before" and "after" samples in key characteristics such as gender, age, socio-economic status, income and whether earning *vs.* retired / not earning (see Table 2b). We therefore consider that the sampling procedure was as effective as practicable in matching the profile of shoppers at the mall and the before and after samples.

[Take in Tables 2a and 2b here]

Measurement Scales

Three scales were used in this study: perception of the mall environment, affect, and reported approach/avoidance behaviour. These scales were based on the literature and used multiple-item measurements. Respondents rated both the test mall and the control mall based on their most recent visit and the items used are based on the differences between them. Scales were first subjected to exploratory factor analysis before being re-screened through confirmatory analysis and introduced in the structural model. Table 3 outlines the measurement scales with selected items, alpha coefficients, factor loadings and sources.

Perception of the mall environment. Retail image has been studied for some decades, formerly having been considered as a formative index, incorporating many attributes (e.g. Gentry and Burns, 1977). More recently, researchers have recognised that the perception of a retail environment can be considered as a latent variable reflected by a modest number of items (Bloemer and De Ruyter, 1998; Chebat et al., 2006). Nevertheless, there is little consistency in previous research as to which are the most salient attributes. The questionnaire therefore included the 15 attributes that previous studies found to be most salient (Finn and Louviere, 1996; Hackett and Foxall, 1994; McGoldrick and Thompson, 1992; Severin et al*.,* 2001; Sit et

al., 2003). In accordance with Bollen (1989) and Kline (2005), the top four loading perception of mall environment items were retained in the SEM model. The unused items are listed below Table 3. The indicators of perception of the store environment thus consist of 'How does [this mall] rate on the following on a scale of 1 – 5 (where 1 is very poor and 5 is very good)? The satisfactory loadings empirically justify following the most recent authors, treating this variable as reflective.

Affect. The dimensions pleasure (Ang et al., 1997), arousal (Wakefield and Baker, 1998) and satisfaction (Rigopoulou et al., 2008) capture the range of affective states relevant to shopping approach/avoidance behaviour (Russell, 1979). The following four items, originally from Mehrabian and Russell (1974), which have been validated many times in retail applications, were used as indicators of affect: (i) unhappy / happy; (ii) melancholic / contented; (iii) unstimulated / stimulated; and (iv) dissatisfied / satisfied. Despite pleasure and arousal being considered as separate variables in many prior studies, our model seeks an overall latent variable to capture shoppers' affective state. This conceptual approach finds empirical support from, e.g., the pragmatic correlation of the error terms of pleasure and arousal by Sherman et al. (1997), notwithstanding those authors including pleasure and arousal as separate variables in their model. Our conceptual approach could have been satisfied by entering affect into the model as a second-order variable of pleasure and arousal but in the event, as we expected and hoped, the consistent loadings on the single latent variable rendered such an awkward model unnecessary. The indicators of affect thus consisted of 'to what extent does (this mall) make you feel … ' (five point scale anchored by, e.g., unhappy – happy).

Digital Signage. We also wished to measure shoppers' perception of digital signage, even though this cannot be used in our model as it has no value in the 'before' condition. We are

unaware of any prior scale for this variable, so we based this measurement on those previously reported for other stimuli such as aroma (e.g. Ellen and Bone, 1998). In reporting these results, we chose to report the before and after results together and therefore digital signage entered the model as a dichotomous variable: digital signage present / not present.

[Take in Table 3 here]

Approach/avoidance. The approach/avoidance variable followed Donovan's et al.'s (1994) adaptation of the Mehrabian and Russell (1974) scale: (i) Time spent shopping; (ii) Number of items bought; (iii) Frequency of visits and from Chebat and Michon (2003): (iv) 'Spending on non-food shopping'. Each of these items is the measure of the test mall utilization relative to the total of the test mall and the control mall.

All respondents answered all the perception of the mall environment; affect; and approach/avoidance questions about both the test and control malls. Numerically, the items other than approach/avoidance are based on the value for the control mall subtracted from the value for the test mall (with 5 added so as to be always positive).

Models

Two models were used to assess the effect of digital signage on shoppers' perception of the environment and the subsequent behavioural response. ANOVA captured the change in shoppers' perception following the introduction of the digital signage in the test mall. Observed changes in the test mall (M) were adjusted for any change in the control mall (C) (e.g. Cook and Campbell, 1979):

$$(M_t - M_{t-1}) - (C_t - C_{t-1}) > 0$$

For measurement purposes, the equation was algebraically modified to:

$$(M_t - C_t) - (M_{t-1} - C_{t-1}) > 0$$

The next step modeled the influence of digital signage on shoppers' positive affect and approach behaviour and investigated mediation through a latent path structural equation model (SEM) using SPSS AMOS (Arbuckle, 2006).

The constructs were used in two different ways. First, as the Cronbach alpha coefficients are satisfactory (> .8), for simplicity of presentation, we subjected the means of the indicators (rescaled 0-1) to ANOVA to compare the values before and after the installation of digital signage at the test mall (Table 4). Second, to investigate mediation and illustrate the relationship between latent variables representing shoppers' perception of the mall environment, positive affect, and approach behaviour, we carried out a path analysis (Figure 2).

RESEARCH FINDINGS

First, it can be reported that respondents' opinions on the digital signage were mainly neutral. To the question: 'What do you think of the screens', 74 percent replied 'neither like nor dislike', 19 percent 'like' or 'like very much' whilst only seven percent said 'dislike' or 'dislike very much'. At the end of the survey, respondents were asked whether they had any comments on the TV / video screens or any other aspects of [the malls]. Only five comments concerned the digital signage: two positives concerning the provision of information; and three negative of which two described the digital signage as a 'waste' and the other as not well located so not serving the purpose of informing shoppers.

The same respondents rated both the test mall and the control mall. The 'Approach' variable is the measure of the test mall utilization relative to the total of the test mall and the control mall. The mean proportions for the test mall are: Spending: 0.38; Time Shopping: 0.39; Items Bought: 0.42; Visits: 0.45; and Approach (average of the foregoing four indicators): 0.41. This means that the respondents' mean utilization of the test mall is 41 percent of the total of the test plus control malls.

The ANOVA indicates that digital signage has a positive effect on income-earning shoppers' perception of the mall environment, M_{before} = .353, M_{after} = .384, F = 4.4 (1, 271), p= .038. The increases in shoppers' positive affect and approach behaviour are smaller and non-significant (Table 4). The positive effect is non-significant with non-earning or retired shoppers. There is no significant difference in shoppers' perceptions of the mall environment between the postal and the e-mail samples M_{postal} = .366, $M_{e\text{-}mail}$ = .371, F = .12 (1, 271), p= .73. Similarly, there are no significant difference in shoppers' positive affect and approach behaviour between the postal and the e-mail samples; and there are also no significant difference in any of the three dependant variables between the postal and the e-mail samples within the 'before' and 'after' results. In the interests of parsimony, the details of these tests are not reported here.

[Take in Table 4 here]

The latent variable path analysis outlines the relationships between the environmental cue (digital signage) and shoppers' response. The SEM exhibits an excellent fit (CFI = .99, RMSEA = .026, χ^2 = 73.1, df = 59, p = .10, χ^2/df 1.2). When all responses are considered, the influence of digital signage on shoppers' perception of the mall environment is significant in the

(hypothesised) one-tailed test [Standardised Coefficient = .11, Critical Ratio (C.R.) = 1.9, p (two tailed) = .06]. These results support H_1, digital signage providing information to shoppers positively influences perceptions of a mall's environment. In the interests of parsimony, this model is not reported diagrammatically but rather, we proceed to the model for the income-earning shoppers.

When the results for income-earning shoppers only are considered, digital signage has a more significant direct influence on shoppers' perception of the mall environment (Standardised Coefficient = .14, C.R. = 2.2, p = 0.03). Shoppers' perception of the mall environment influences shoppers' emotions (Coefficient = .79, C.R. = 11.2, p < .001). In turn, shoppers' affect impacts approach behaviour (Coefficient = .66, C.R. = 89.1, p < .001) (Figure 2). These results for income-earning shoppers also exhibit an excellent fit (CFI = .98, RMSEA = .037, χ^2 = 81.2, df = 59). As is common for reasonable size samples, p is significant at .002 but other measures confirm fit with χ^2/df 1.6. In line with H_1, digital signage providing information to shoppers positively influences perceptions of a mall's environment. In line with expectations, this finding is more significant with the income-earning shoppers than with the total sample. Sample size considerations preclude a between-groups analysis of the moderation effect.

[Take in Figure 2 here]

The significant path from the dichotomous variable, digital signage to the perception of the mall environment confirms the differential effect of the digital signage between the two conditions. According to McArdle (2001), latent mean scores are more reliable for comparing means over a time series than are direct change score analyses. Accordingly, using a multi-group model, we investigate whether the latent means of the constructs vary between the two

conditions. First, we confirm that the measurement weights do not vary significantly between these conditions ($\Delta\chi^2$ = 6.61, Δdf =9, p = 0.67). The latent means in the 'with digital signage' condition are significantly higher for: the perception of the mall (C.R. = 2.26, p = 0.024); and affect (C.R. = 1.94, p = 0.053, significant in the one-tail test). This means that respondents rate the perception of the mall significantly higher and have significantly higher positive affect in the 'with digital signage' condition compared with the 'without digital signage' condition. The latent mean of approach is also in the expected direction but not sufficiently large for significance (C.R. = 1.46, p = 0.14). In the interests of parsimony, we do not illustrate the latent mean models diagrammatically.

Testing for cognitive mediation (Baron and Kenny, 1986), we first demonstrate that digital signage has a positive effect (one-tailed test) on affect in the absence of the mediating variable, perception of the mall, using the latent mean test in the paragraph above, i.e. affect is significantly higher (one-tailed p = 0.025) in the 'with digital signage condition. Second, when the mediator, perception of the mall, is included, the direct relationship between digital signage and affect becomes non-significant (C.R. = -1.16, p = 0.25). Third, the R^2 of affect is only 0.01 in the unmediated condition compared with 0.63 in the final mediated model. These three tests fulfill Baron's and Kenny's (1986) conditions for mediation, supporting H_2, the effect of digital signage on shoppers' affect is fully mediated by the perception of the mall environment, demonstrating that Lazarus's (1991) principle of cognitive mediation is valid for digital signage. Similarly, it is also noted that including a direct path in the SEM between digital signage and approach is non-significant (C.R. = -0.40, p = 0.69). This is in line with most retail atmospherics models that test specific stimuli (e.g. Chebat and Michon, 2003, who test aroma in a mall), notwithstanding that authors seldom draw attention this aspect.

In the 'Conceptual Framework' section above, we introduced a possible alternative conceptualization based on the argument that atmospheric stimuli may influence emotion (Donovan and Rossiter, 1982) and that emotion influences cognitive perceptions (Zajonc and Markus, 1984). This route is not hypothesised, on the grounds that the digital signage content used in this study was designed to influence cognitions rather than emotions. Nevertheless, we also evaluate that model for comparison. When the results for income-earning shoppers only are considered, digital signage has a marginally significant direct influence on shoppers' perception of the mall environment (Standardised Coefficient = .12, C.R. = 1.8, p = 0.07). Shoppers' affect influences shoppers' perception of the mall environment (Coefficient = .82, C.R. = 11.7, p < .001). In turn, shoppers' perception of the mall environment impacts approach behaviour (Coefficient = .56, C.R. = 7.4, p < .001). These results for income-earning shoppers exhibit a good fit (CFI = .96, RMSEA = .063, χ^2 = 124.4, df = 60. p = .000, χ^2/df 2.1. The influence of the digital signage on affect is only marginally significant and the fit of the hypothesised model is significantly (p < 0.001) better than this alternative conceptualization. Nevertheless, this remains a promising area for future research. In the interests of parsimony, we do not include this alternative model diagrammatically.

DISCUSSION

The environmental psychology paradigm is not new to retail atmospherics. Ample research has shown that environmental cues will impact shoppers' cognition and emotion, and trigger some approach behaviour (Turley and Milliman, 2000). What is new here is the advent of digital signage or digital communications networks in the retail atmospheric toolbox as a

stimulus with a significant effect, as predicted by the LCM. Digital signage has a dual usage: it conveys information when and where shoppers are in the mood to shop, and it can have a strong entertainment component. These results indicate that digital signage is an effective stimulus, adding to positive perceptions of the mall environment, emotions and approach behaviour such as spending, as predicted by the LCM. This study cannot claim to be a test of the LCM, which would entail measuring the availability and allocation of cognitive resources; and the information rate of the stimulus; and comparing with a lower-information rate stimulus. Nevertheless, the effectiveness of digital signage as an atmospheric stimulus is consistent with the LCM, which predicts the effectiveness of vivid moving visual images. The LCM holds that people have a limited capacity to process information and therefore allocate processing resources to those most demanding stimuli that have a high information rate and distinctive features such as movement, colour and vividness. The moving images of digital signage should attract viewers' attention and act as a more effective atmospheric stimulus, with higher recall of messages than those that are static or less vivid. The confirmation of digital signage as an effective stimulus therefore extends the LCM from television to digital signage.

The research shows that digital signage is effective with income-earning shoppers, who are generally in a hurry to complete their shopping chores. Digital signage will inform them about product offerings and promotions. This may simplify their shopping experience, which Kalitcheva and Weitz (2006) have found to be preferred by high task-orientated shoppers. These shoppers might also be more familiar with plasma screen technology. This more-evaluative pattern for income-earning shoppers parallels findings of Raajpoot et al. (2008), who report that the effect of the overall evaluation of a shopping mall on repatronage is greater for working women than non-working.

On the other hand, digital signage may not enhance the perception of the mall environment among non-working or retired patrons (although their representation in the total sample is too small to justify reporting in detail). The latter are already spending time in the mall for other purposes than shopping, namely entertainment or passing time (e.g. Bloch et al., 1994). It may well be that this particular digital signage may not work so well with retired, unemployed or inactive people because it is purely informational (e.g. prices, promotions, special offers and community news) and has no or little entertaining effect on those just spending time in the mall. If the digital signage content were entertaining, the story might be totally different.

Mediation testing (Baron and Kenny, 1986) illustrates that the impact of digital signage on shoppers' emotion and approach behaviour is fully mediated by shoppers' perception of the mall environment and positive affect (Figure 2). The standardised total effects are reported in Table 5. The total effect of digital signage on approach behaviour (.07) and emotions (.11) is significant.

In order to explore the alternative emotion → cognition conceptualization, we considered the ELM of Petty and Cacioppo (1986). In this instance, with the digital signage content being designed to influence cognition rather than emotions, the hypothesised cognition → emotion model fitted the data significantly better. Nevertheless, the results provide food for thought, suggesting future research into the alternative conceptualization and the potential for digital signage to influence approach behaviour by priming through the peripheral 'wallpaper' route rather than (or in addition to) providing cognitive information.

[Take in Table 5 here]

The impact of the digital signage network in the mall was cross-validated by traffic counting. Twelve months before the installation of the digital signage network, traffic tracking was undertaken. Footfall traffic (*vs.* a national benchmark) was 6.1 percent higher after the installation of the digital signage compared with the same period in the previous year.

MANAGERIAL IMPLICATIONS AND FURTHER RESEARCH

This quasi-experimental study of the little-researched atmospheric stimulus of digital signage indicates that it significantly enhances the perception of the mall environment and approach behaviour among income-earning busy shoppers, who are generally in a hurry to complete their shopping. For these shoppers, digital signage may facilitate their tasks and inform them about product offerings and promotions. On the other hand, digital signage is not highly evaluated by retired and non-working patrons who are already spending time in the malls for entertainment or passing time (Bloch et al., 1994). The particular digital signage in this study was used to convey information (e.g. advertising) and had little or no entertaining effect on those just spending time in the malls. Mall managers therefore need to consider market segmentation in the design of digital signage content. We have demonstrated in this study that information-based content is suitable for targeting the higher-spending income-earning shoppers. Entertainment-based content may well be preferred by retired and non-working shoppers, although further research is recommended to confirm this. In this study, the formal testing of moderation effects was precluded by considerations of sample size but remains an objective for future studies.

Results confirm expectations that the cognitive construct of mall perception mediates the effects of stimulus-emotion links. The results demonstrate that customer information strategies using digital signage can be useful and effective for mall managers.

These results can be seen in the wider context of improvements to shopper information, *viz* the convergence of online, mobile and in store shopping (Pantano, 2010; Pantano and Timmermans, 2011), as shoppers are increasingly using smartphone apps for shopping information and to take advantage of special offers (Microsoft, 2011). Taking this a step further, retailers and suppliers now have the opportunity to bring together location-aware smartphone apps with digital signage. For example, shoppers can have a 'wallet' for special offer coupons that they can collect online and alternatively by using a phone to scan a QR code at the bottom of a digital signage screen. Coupons can be displayed and redeemed at the checkout. Suppliers or retailers can then integrate shopper data with loyalty programs, providing location-based targeting and segmentation data (EnQii, 2011). Further research on the integration of smartphone and digital signage technologies is recommended.

This research is limited in referring to a single location. The results can be used to model the likely effects of similar changes at other malls. Supporting LCM, manipulating a stimulus comprising moving images can increase shoppers' approach behaviour towards a mall, thus acting as a marketer-controlled atmospheric stimulus variable. As predicted by cognitive mediation theory, the effect of the stimulus is not direct but mediated by the perception that shoppers hold of the environment.

This study has considered presence or absence of digital signage as a dichotomous variable. Future studies should expand on the effects of digital signage in more depth. Central to this is a requirement for scale development into preference for digital signage.

The results are also limited in as much as the content shown on the digital signage screens was almost entirely information-based, having limited entertainment value, whereas the LCM, supported by evolutionary psychology, predicts that people pay more attention to emotion-eliciting communications. If processing resources are limited (e.g. if busy shoppers perceive digital signage only as 'wallpaper'), emotion rather than cognition may be expected to have the stronger effect on consumer choices (Shiv and Fedorikhin, 1999). Given that hedonic benefits are more likely to increase positive affect and loyalty than utilitarian ones (e.g. Chitturi et al., 2008) and many consumers use hedonic shopping for emotion-repair purposes (Kemp and Kopp, 2011), future research could well evaluate the effects of entertaining content, which may in particular be more effective for retired and unemployed shoppers and might conceivably have a direct effect on positive emotion, necessitating a new evaluation of the emotion → cognition model.

This paper demonstrates the effect of a digital signage network in contributing to retail atmospherics by influencing shoppers' perceptions of the overall retail environment. Pleasant emotion is the dominant influence on approach behaviour but in this study, the mall environment is an antecedent to positive affect. The before and after results suggest that the digital signage stimulus enhances shoppers' evaluations of the retail environment. Shoppers' assessment of their environment triggers positive emotions which in turn influence shoppers' approach behaviours, including additional spending. The results are consistent with the cognitive mediation adaption of the environmental psychology model: *Stimulus* → *Perception* → *Emotion* → *Response* and the LCM predicting the effectiveness of vivid moving visual images. Future research may extend the generalization of digital signage to other retail situations.

FOOTNOTE

Discriminant validity. Following Thomson, MacInnis and Park (2005), we accept the results of the factor analysis (Table 3) as confirmation that the constructs are distinct. This is notwithstanding that the variables 'perception of the mall environment' and 'emotion' do not meet the stricter Fornell and Larcker (1981) criterion. Thus, the average variances extracted are: perception of the mall environment = .56; affect = .62; and approach = .48. These are greater than the squared correlations between the constructs except for affect/perception of the mall environment (0.63). To confirm that these two constructs are distinct and set aside the Fornell and Larcker criterion, we have evaluated a modified model in which those two variables are combined (Anderson and Gerbing, 1988). The fit of this combined model to the data is significantly (p = < 0.001) worse than the hypothesised model (CFI = .92, RMSEA = .083, χ^2 = 175.0, df = 61, p = .000, χ^2/df 2.9), justifying discriminant validity of the two constructs and preference for the hypothesised model. Moreover, the criterion that we used to show the discriminant validity is stricter than those used in recent construct development papers (e.g., Thomson et al., 2005).

REFERENCES

Anderson JC, Gerbing DW. 1988. Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychological Bulletin* **103** (3): 411-423.

Ang SH, Leong SM, Lim J. 1997. The mediating influence of pleasure and arousal on layout and signage effects. *Journal of Retailing and Consumer Services* **4** (1):13-24.

Arbuckle JL. 2006. *Amos (Version 7)*. SPSS: Chicago.

Aubert-Gamet V, Cova B. 1999. Servicescapes: From modern non-places to postmodern common places. *Journal of Business Research* **44** (1):37-45.

Aubert-Gamet V, Hardesty DA, Suter T. 2003. Color and shopping intentions: the intervening effect of price fairness and perceived affect. *Journal of Business Research* **56** (7): 541-551.

Babin BJ, Hardesty DA, Suter T. 2003. Color and shopping intentions: The intervening effect of price fairness and perceived affect. *Journal of Business Research* **56** (7): 541-555.

Bakamitsos GA, and Siomkos GJ. 2004. Context effects in marketing practice: The case of mood. *Journal of Consumer Behaviour* **3** (4): 304-314.

Backes N. 1997. Reading the shopping mall city. *Journal of Popular Culture* **31** (3):1-17.

Baker J, Grewal D, Parasuraman A. 1994. The influence of store environment on quality inferences and store image. *Journal of the Academy of Marketing Science* **22** (4): 328-339.

Baker J, Grewal D, Parasuraman A. Voss GB. 2002. The influence of multiple store environment cues on perceived merchandise value and patronage intentions. *Journal of Marketing* **66** (2): 120-141.

Baron RM, Kenny D. 1986. The moderator-mediator distinction in social psychology research: conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology* **51**: 1173-1182.

Beverland M, Lim EAC, Morrison M, Terziovski M. 2006. In-store music and consumer–brand relationships: Relational transformation following experiences of (mis)fit. *Journal of Business Research* **59**: 982-989.

Bitner MJ. 1990. Evaluating service encounter: the effects of physical surrounding and employee responses. *Journal of Marketing* **54** (2): 69-82.

Bitner MJ. 1992. Servicescapes: The impact of physical surroundings in customers and employees. *Journal of Marketing* 56 (April): 57-71.

Bloch PH, Ridgway NM, Dawson SA. 1994. The shopping mall as consumer habitat. *Journal of Retailing* **70** (1):23-42.

Bloemer J, de Ruyter K. 1998). On the relationship between store image, store satisfaction and store loyalty. *European Journal of Marketing* **32** (5/6): 499-513.

Bollen KA. 1989. *Structural equations with latent variables*. John Wiley & Sons: New York.

BRC. 2011. *BRC-KPMG Retail Sales Monitor November 2011: Worst Retail Sales Growth for Six Months*. British Retail Consortium / KPMG: London.

Burke RR. 2002. Technology and the customer interface: what consumers want in the physical and virtual store. *Journal of the Academy of Marketing Science* **30** (4): 411-432.

Carmody T. 2010. Amazon's Price Check Might Be Perfect Smartphone Shopping App, Gadget Lab. Available at http://www.wired.com/gadgetlab/2010/11/amazons-price-check-might-be-perfect-smartphone-shopping-app/ [accessed on 22 December 2011].

Chebat JC, Michon R. 2003. Impact of ambient odors on mall shoppers' emotions, cognition and spending: a test of competitive causal theories. *Journal of Business Research* **56** (7): 529-539.

Chebat JC, Morrin M. 2007. Colors and cultures: exploring the effects of mall décor on consumer perceptions. *Journal of Business Research* **60**:189-196.

___, Sirgy MJ, St-James V. 2006. Upscale image transfer from malls to stores: a self-image congruence explanation. *Journal of Business Research* **59** (12): 1288-1296.

Chitturi R, Raghunathan R, Mahajan V. 2008. Delight by design: the role of hedonic vs. utilitarian benefits. *Journal of Marketing* **72** (May): 48-63.

Clarke R. 2003. Question: when is a retailer not a retailer? Answer: when it's a media owner. *The European Retail Digest* **(38)**: 20-23.

Cohen JB, Areni CS. 1991. Affect and consumer behaviour, in *Handbook of consumer behaviour* TS Robertson and HH Kassarjian (ed.). Prentice Hall: Englewood Cliffs, NJ; 188-240.

Computerworld.com. 2007. Cisco enters digital signage market. Available at www.computerworld.com [accessed on 6 August, 2008].

Cook TD, Campbell DT. 1979. *Quasi-experimentation: design and analysis issues for field settings*. Houghton-Mifflin: Boston.

Dennis C. 2005. *Objects of Desire: Consumer Behaviour in Shopping Centre Choices.* Palgrave MacMillan: Basingstoke.

Dennis C, Newman A, Michon R, Brakus J, Wright LT. 2010. The Mediating Effects of Perception and Emotion: Digital Signage in Mall Atmospherics. *Journal of Retailing and Consumer Services* **17** (3): 205-215.

Donovan RJ, Rossiter JR. 1982. Store atmosphere: an environmental psychology approach. *Journal of Retailing* **58** (Spring): 34-57.

Donovan RJ, Rossiter JR, Marcoolyn G, Nesdale A. (1994). Store atmosphere and purchasing behaviour. *Journal of Retailing* 70 (3): 283-294.

Dubé L, Morin S. 2001. Background music pleasure and store evaluation: intensity effects and psychological mechanisms. *Journal of Business Research* **54** (2): 107-113.

Ellen PS, Bone PF. 1998. Does it matter if it smells? Olfactory stimuli as advertising executional cues. *Journal of Advertising* **27** (4): 29-39.

EnQii. 2011. Closing the Loop. Engage Passport: A Platform For Cross-Channel Digital Advertising, EnQii Group. Available at http://www.enqii.com/newsletter/march2011/EnGage_Passport_Whitepaper.pdf [accessed on 22 December 2011].

Finn A, Louviere JJ. 1996. Mall image, consideration and choice: anchor store contribution. *Journal of Business Research* **35**: 241-251.

Fornell C, Larcker D. 1981. Evaluating structural equation models with unobservable variable. *Journal of Marketing Research* **18** (February): 39-50.

Frost-Norton T. 2005. The future of mall research: Current trends affecting the future of marketing research in malls. *Journal of Consumer Behaviour* **4** (4): 293-301.

Foxall GR, Soriano MY. 2005. Situational influences on consumer's attitudes and behaviour. *Journal of Business Research* **58** (4): 518-525.

Garlin FV, Owen K. 2006. Setting the tone with the tune: a meta-analytic review of the effects of background music in retail settings. *Journal of Business Research* **59**: 755-764.

Graham E. 1988. The Call of the mall. *Wall Street Journal* **May 13**: 7R.

Grewal D, Ailawad KL, Gauri D, Hall K, Kopalle P, Robertson JR. 2011. Innovations in retail pricing and promotions. *Journal of Retailing* **87S** (1): S43-S52.

Guy CM. 1994. Whatever happened to regional shopping centres. *Geography* **79** (4): 293-312.

Hackett PMW, Foxall GR. 1994. A factor analytic study of consumers' location specific values: a traditional high street and a modern shopping mall. *Journal of Marketing Management* **10**: 163-178.

Hangland A, Cimbalo RS. 1997. Human ethology: age and sex differences in mall walking. *Perceptual & Motor Skills* **85** (3): 845-846.

Herrington JD, Capella LM. 1996. Effects of music in service environments: a field study. *Journal of Services Marketing* **10** (2): 26-41.

Hildebrandt L. 1988. Store image and the prediction of performance in retailing. *Journal of Business Research* **17**: 91-100.

Hui M, Dubé L, Chebat JC. 1997. The impact of music on consumers' reaction to waiting for services. *Journal of Retailing* **73** (1): 87-104.

IMRG. 2011. *IMRG Capgemini e-Retail Sales Index: December 2011*. IMRG Cap Gemini: London.

Javelin. 2011. *How many stores will we really need? UK non-food retailing to 2020*. Javelin Group: London.

Kalitcheva VD, Weitz BA. 2006. When should a retailer create an exciting store environment? *Journal of Marketing* **70** (1): 107-118.

Kalyanam K, Lal R, Wolfram G. 2010. Future store technologies and their impact on grocery retailing, in *Retailing in the 21st Century, Current and Future trends, Second Edition*, Manfred Kraft and Murali K. Mantrala (ed.). Springer: Berlin Heidelberg; 141-158.

Kemp E, Kopp S. 2011. Emotion regulation consumption: When feeling better is the aim. *Journal of Consumer Behaviour* **10** (1): 1-7.

Kline RB. 2005 *Principles and practice of structural equation modeling*. Second edition. The Guilford Press: New York.

Lang A. 2000. The limited capacity model of mediated message processing. *Journal of Communication* **50** (1): 46-70.

Lazarus RS. 1991. *Emotion and adaptation*. Oxford University Press: New York.

Lewis GH. 1990. Community through exclusion and illusion: the creation of social worlds in an American shopping mall. *Journal of Popular Culture* **24** (2): 121-136.

Li H, Bukovac JL. 1999. Cognitive impact of banner ad characteristics: an experimental study. *Journalism and Mass Communication Quarterly* **76** (2): 341-353.

Machleit KA, Kellaris JJ, Eroglu SA. 1994. Human versus spatial dimensions of crowding perceptions in retail environments: a note on the measurement and effect on shopper satisfaction. *Marketing Letters* **5** (2): 183-194.

McArdle JJ. 2001. A latent difference score approach to longitudinal dynamic structural analysis, in *Structural Equation Modeling: Present and Future*, Robert Cudeck, Stephen Du Toit, Dag Sorbom (ed.). Scientific Software International: Lincolnwood, IL; 341–380.

McGoldrick PJ, Thompson MG. 1992. The role of image in the attraction of the out of town mall. *The International Review of Retail, Distribution and Consumer Research* **2** (1): 81-98.

McGoldrick PJ, Pieros CP. 1998. Atmospheres, Pleasure And Arousal: The Influence Of Response Moderators. *Journal of Marketing Management* **14** (1/3): 173-197.

Mehrabian A, Russell JA. 1974. *An approach to environmental psychology*. MIT Press: Cambridge, MA.

Microsoft. 2011. *Location Based Services Usage and Perceptions Survey*. Microsoft / Cross Tab Marketing Services.

Newman A, Dennis CE, Zaman S. 2006. Marketing images and consumers' experiences in selling environments. *Marketing Management Journal* (Fall): 515-599.

North AC, Hargreaves DJ, McKendrick J. 1999. The influence of in-store music on wine selections. *Journal of Applied Psychology* **84** (2): 271-276.

Outdoor Advertising Association of America. 2009. *Digital billboards: Outdoor advertising's glowing future*. Available at http://www.oaaa.org/marketingsources/digital.aspx [accessed on 19 December 2009].

Pantano E. 2010. New technologies and retailing: Trends and directions. *Journal of Retailing and Consumer Services* **17** (3): 171-172.

Pantano E, Naccarato G. 2010. Entertainment in retailing: The influences of advanced technologies. *Journal of Retailing and Consumer Services* **17** (3): 200-204.

Pantano E, Timmermans H. (ed.). 2011. *Advanced Technologies Management for Retailing: Frameworks and Issues*. IGI Global: Hershey, PA.

Petty RE, Cacioppo JT. 1986. The elaboration likelihood model of persuasion, in *Advances in experimental social psychology, 19*, L. Berkowitz (ed.). Academic: New York; 123-205.

Pham MT. 2004. The logic of feeling. *Journal of Consumer Psychology* **14** (4); 360-369.

Puccinelli NM. 2006. Putting your best face forward: the impact of customer mood on salesperson evaluation. *Journal of Consumer Psychology* **16** (2): 156-162.

Raajpoot NA, Sharma A, Chebat JC. 2008. The role of gender and work status in shopping center patronage. *Journal of Business Research* **61**: 825-833.

Reeves B, Nass C. 1996. *How people treat computers, television and new media like real people and places*. Cambridge University Press: Stanford, CA.

Reynolds J. 1993. The proliferation of the planned shopping centre, in *Retail Change Contemporary Issues,* DF Bromley, CJ Thomas (ed.). UCL: London; 70-87.

Reynolds KE, Ganesh J, Luckett M. 2002. Traditional malls *vs.* factory outlets: comparing shopper typologies and implications for retail strategies. *Journal of Business Research* **55** (9): 687-696.

Rigopoulou ID, Tsiotsou RH, Kehagias JD. 2008. Shopping orientation-defined segments based on store-choice criteria and satisfaction: an empirical investigation. *Journal of Marketing Management* **24** (9/10): 979-995.

Rogers EM. 1995. *The Diffusion of Innovations.* 4th edition. Free Press: New York.

Roy A. 1994. Correlates of mall visit frequency. *Journal of Retailing* **70** (2): 139-161.

Ruíz FJM. 1999. Image of suburban shopping malls and two-stage versus uni-equational modelling of the retail trade attraction: An empirical application. *European Journal of Marketing* **33** (5/6): 512-530.

Sherman E, Mathur A, Smith RB. 1997. Store environment and consumer purchase behavior: mediating role of consumer emotions. *Psychology and Marketing* **14** (4): 361-378.

Shim S, Eastlick MA. 1998. The hierarchical influence of personal values on mall shopping attitude and behavior. *Journal of Retailing* **74** (1): 139-160.

Shiv B, Fedorikhin A. 1999 Heart and mind in conflict: the interplay of affect and cognition in consumer decision making. *Journal of Consumer Research* **26** (December): 278-292.

Sit J, Merrilees W, Birch D. 2003. Entertainment-seeking mall patrons: the missing segments. *International Journal of Retail and Distribution Management* **31** (2): 80-94.

Smith P, Burns DJ. 1996. Atmospherics and retail environments: the case of the "power aisle". *International Journal of Retail and Distribution Management* **24** (1): 7-14.

Spangenberg ER, Sprott DE, Grohmann B, Tracy DL. 2006. Gender-congruent ambient scent influences on approach and avoidance behaviors in a retail store. *Journal of Business Research*. **59**: 1281-1287.

Summers TA, Hebert PR. 2001. Shedding some light on store atmospherics. Influence of illumination on consumer behavior. *Journal of Business Research* **54**: 145-150.

Spies K, Hesse F, Loesch K. 1997. Store atmosphere, mood and purchasing behavior. *International Journal of Research in Marketing* **14**: 1-17.

Taylor SE, Thompson SC. 1982. Stalking the elusive vividness effect. *Psychological Review* **89** (2): 155-181.

The Economist. 2006. Signs of the Times **378** (8468), (3/11/2006).

Theodoridis PK, Chatzipanagiotou KC. 2009. Store image attributes and customer satisfaction across different customer profiles within the supermarket sector in Greece. *European Journal of Marketing* **43** (5/6): 708-734.

Thomson M, MacInnis DJ, Park CW. 2005. *Journal of Consumer Psychology* **15** (1): 77–91.

Turley LW, Chebat JC. 2002. Linking Retail Strategy, Atmospheric Design and Shopping Behaviour. *Journal of Marketing Management* **18** (1/2): 125-144.

Turley LW, Milliman RE. 2000. Atmospheric effects on shopping behavior, a review on the experimental evidence. *Journal of Business Research* **49**: 193-211.

Underhill P. 2004. *Call of the Mall*. Simon & Schuster: New York.

Wakefield KL, Baker J. 1998. Excitement at the mall: determinants and effects on shopping response. *Journal of Retailing* **74** (4): 515-539.

Wilson M. 2005. Atmosphere key to well-being. *Chain Store Age* **81** (10): 94.

Woodruffe-Burton H, Eccles S, Elliott R. 2002. Towards a theory of shopping: a holistic framework. *Journal of Consumer Behaviour* **1** (3): 256-266.

Wright LT, Newman A, Dennis CE. 2006. Enhancing consumer empowerment. *European Journal of Marketing* **40** (9/10): 925-935.

Yalch R, Spangenberg E. 1990. Effects of store music on shopping behavior. *Journal of Consumer Marketing* **7** (Spring): 55-63.

Yoo C, Park J, MacInnis DJ. 1998. Effects of store characteristics and in-store emotional experiences on store attitude. *Journal of Business Research* **42** (3): 253-263.

Zajonc RB. 1980. Feeling and thinking: Preferences need no inferences. *American Psychologist* **35**: 151–175.

Zajonc RB, Markus H. 1984. Affect and cognition: the hard interface, in *Emotions, cognition, and behavior,* Carol E. Izard, Jerome Kagan,, Robert B. Zajonc (eds). Cambridge University Press: Cambridge; 73-102.

***Table 1**: Selected Prior Research into the Effects of Specific Retail Atmospheric Stimuli*

Study	*Stimulus*	*Influences (findings)*	*Sample*
		Behavioural influences	***(n = usable questionnaires)***
Herrington and Capella (1996)	Music	Sales in supermarkets	In-store survey, n=140 (89 aware of background music)
Yalch and Spangenberg (1990)	Music	Sales in department stores	In-store experimental design, n = 86 (foreground music = 33, background music = 32, and control =21)
Hui et al. (1997)	Music	Responses to waiting in banks	Retail banking video setup, n = 116 undergraduate students, experimental design (4 types of music plus control)
North et al. (1999)	Music	Sales in wine shops	In-store 2x2 experimental display; German and French music, and German and French wines, n = 82
Dubé and Morin (2001)	Music	Positive affect and approach behaviors such as spending	In-store survey, n = 110 shoppers aware of background music post-categorised in the low pleasure intensity (48) and high pleasure intensity (62) conditions
Spangenberg et al. (2006)	Gender-appropriate aroma	Perceptions of apparel store environment, merchandise and approach behaviors such as spending	Pretesting of feminine and masculine scents (n = 300 students, faculty and staff); in-store field experiment (82 males, 99 females) in congruent and incongruent scent conditions.
Chebat and Michon (2003)	Aroma	Perceptions of mall environment, positive affect and spending	Mall intercept, n=145 with aroma (447 control)
Summers and Hebert, (2001)	Lighting	Number of items handled by shoppers and time spent at a display	Field experiment, shoppers observation (n = 2367) in a 2 (stores) x 2 (lighting conditions) experimental design
Babin et al. (2003)	Colour and lighting	Positive affect and purchase intention in an apparel store	209 females from the university community, average age 33.2 years
Sherman et al. (1997)	Social, image, design and ambience	Positive affect and approach behaviors such as spending	Mall exit intercept n=909
Dennis et al. (2010)	Digital signage	Patronage behaviors including sales	Mall intercept survey, n=315
		Cognitive influences	
Beverland et al. (2006)	Music "fit"	Perceptions of an apparel brand	20 in-depth consumer interviews
Smith and Burns, 1996	Store layout	Price perceptions	Warehouse grocery store intercept before and after manipulation (n = 182), with control (n = 198)
Baker et al. (1994)	General environment	Store image of a card and gift store	N = 297 undergraduates in a laboratory experiment (2x2x2) opposing prestige to various discount conditions
		Affective influences	
Machleit et al. (1994)	Crowding	Shopper (dis)satisfaction	1) University bookstore video simulating high and low crowding situations (n = 76 undergraduates) 2) Actual bookstore under various crowding conditions (n = 140) 3) Two grocery stores under various crowding conditions (n = 232 shoppers)
Yoo et al. (1998)	Facilities and product assortment	Shoppers' positive affect	Shoppers intercept (n = 294) in two large Korean department stores
		Perception of mall environment	
Finn and Louvière (1996)	Physical environment	Mall image and patronage	Longitudinal mail surveys in 1988 (n=339), 1992 (n=1042), and 1993 (n=848)
Hildebrandt (1998)	Physical environment	Mall image and patronage	Household panel (n = 2105) over a 9-month period
Ruíz (1999)	Physical environment	Mall image and patronage	Door-to-door survey (n = 177)
Wakefield and Baker (1998)	Physical environment	Positive affect and desire to stay longer	Community mall intercept (n = 438)
Chebat et al. (2006)	Mall image and atmosphere	Mall image influences store image	Video mall simulation (n = 200 shoppers) in an experimental factorial design; store types (2), mall image (2), shoppers SES (2). Dependent variable: self-congruity and store image

Table 2a: Survey Responses

	Before digital signage	***After digital signage***	***Total***
email	67 (6.7%)	117 (11.7%)	184
Post	102 (10.2%	71 (7.1%)	173
Total	169	188	357

Table 2b: Sample Characteristics

	Before digital signage	***After digital signage***	***Overall***	***Pearson χ^2 (1df) p***
Percent female	71.7	65.2	68.3	.19
Age: percent up to 44 years	47.9	55.3	51.8	.16
Percent higher socio-economic employment: managerial, administrative, professional, supervisory or clerical	73.4	78.1	75.8	.36
Income: percent over £35,000	42.8	50.9	47.2	.16
Percent income-earning	76.9	76.1	76.5	.85

Table 3: Measurement Scales

	Preference for Digital Signage [1]	→ ***Perception of Mall Environment***	→ ***Positive Affect***	→ ***Approach Behaviour***
Explained Variance	15.40%	24.30%	25.50%	14.30%
Alpha	.90	.83	.89	.82
Preference for Digital Signage (adapted from Ellen and Bone, 1998)				
Digital signage dislike or like very much	**.91**			
Digital signage very poor/very good	**.94**			
Perception of Mall Environment (McGoldrick and Thompson, 1992)				
Welcoming atmosphere		**.87**		
General layout		**.83**		
Nice place to spend time		**.76**		
An "in-place" to go (stylish)		**.58**		
Affect (Mehrabian and Russell, 1974)				
Unhappy / Happy			**.89**	
Melancholic / Contented			**.84**	
Unstimulated / Stimulated			**.82**	
Dissatisfied / Satisfied			**.61**	
Approach Behaviour (Adapted from Donovan and Rossiter, 1982)				
Spending (non-food)				**.91**
Number of items bought				**.85**
Time spent shopping				**.70**
Frequency of visits				**.61**

Extraction: Principal Components, Rotation: Oblimin with Kaiser Normalization, loadings < 0.3 suppressed. Based on five-point questionnaire scales, e.g. very unhappy – very happy for emotions; very poor – very good for perceptions such as General layout (except for Approach: Frequency of visits per month, Spending on non-food items per month, Number of non-food items bought on a typical visit and Time spent shopping in minutes on an average visit: scale variables, proportion of the total of the test mall plus the control mall). In the text, for simplicity, we refer to, e.g., 'positive affect' meaning 'negative / positive affect where positive affect is at the numerically higher end of the scale'

The top four loading perception of mall environment items were retained in the SEM model. Those unused were: (i) Quality of the stores; (ii) Wide selection of products; (iii) Low prices; (iv) Availability of public seating; (v) Cleanliness of the mall; (vi) Indoor shopping; (vii) Other shoppers are nice people; (viii) Availability of good toilets; (ix) Helpfulness of staff; (x) Safety and security from crime and anti-social behaviour; (xi) Eating and drinking facilities.

[1] *The scale variable of preference for the digital signage was not used in the SEM analysis as it has no value in the 'before' condition.*

Table 4: Impact of Digital Signage

Variables	***Before***	***After***	***df***	***F***	***p***
Perception of environment	0.353	0.384	1, 271	4.4	0.038
Affect	0.409	0.429	1, 271	2.5	0.117
Approach (visits, spending, items bought and time spent shopping)	0.397	0.419	1, 271	1.4	0.282

Before n=130 vs after n=143, income earning shoppers only, variables scaled 0-1.

Table 5: Standardised Total Effects

	Digital signage	***Mall environment***	***Pleasant emotion***
Mall environment	.14		
Emotions	.11	.79	
Approach behaviour	.07	.52	.66

Income earning shoppers only

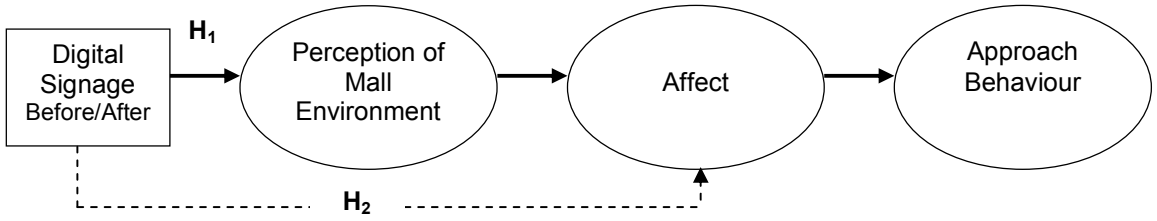

Figure 1: *Research Hypotheses*

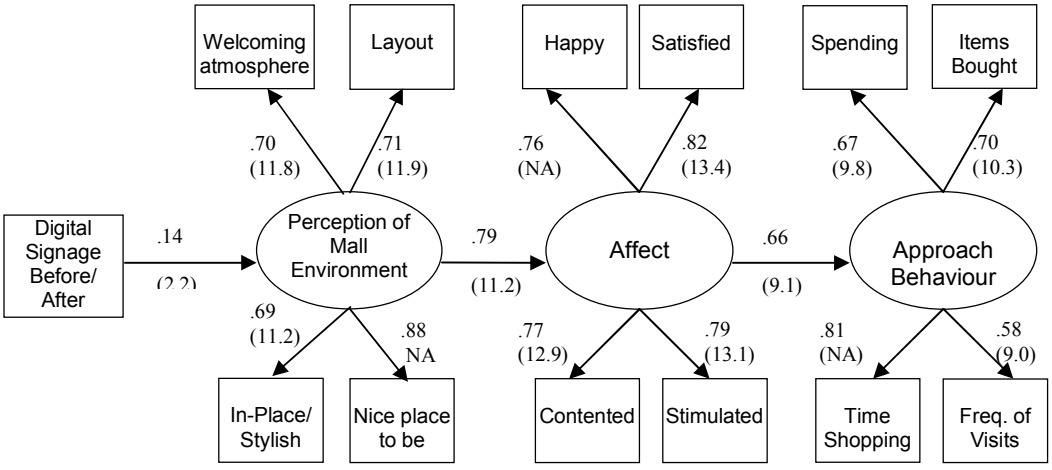

Figure 2: *Latent Path Analysis – Income-Earning Respondents Only*

Standardized coefficients (Critical Ratio)
Method: ML, χ^2 = 81.2, df = 59, CFI = .98, RMSEA = .037